

## SPECIFICATIONS

### New Headquarters Building

Inland Fisheries and Wildlife – East Campus  
Augusta, Maine

Prepared For:



**Maine Department of Inland Fisheries & Wildlife**  
284 State Street, SHS 41  
Augusta, Maine 04333

January 29, 2025

Prepared By:



**OAK POINT**  
ASSOCIATES

architecture  
engineering  
planning

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INLAND FISHERIES AND WILDLIFE – EAST CAMPUS  
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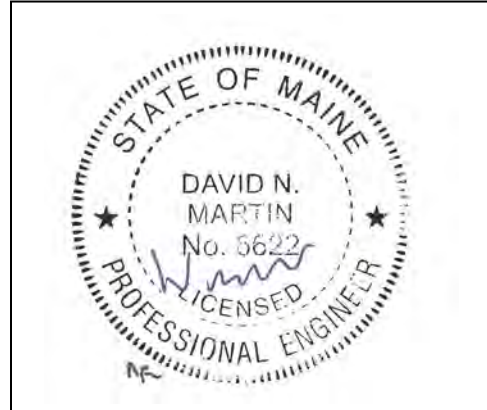
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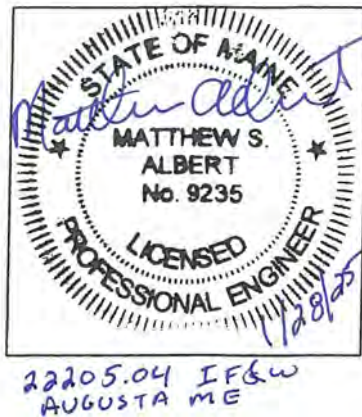
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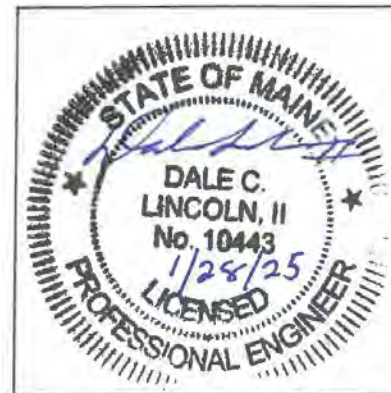
Tyler G. Barter, AIA, Architect



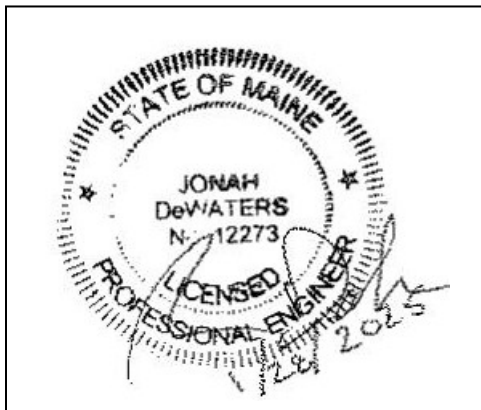
David N. Martin, P.E., S.E., Structural Engineer



Matthew Albert, P.E., Mechanical Engineer



Dale C. Lincoln, II, P.E., Electrical Engineer



Jonah DeWaters, P.E., Civil Engineer



Allison Towne DiMatteo, PLA, Landscape Architect

END OF SECTION

**00 11 13**  
**Notice to Contractors**

**NEW HEADQUARTERS BUILDING - INLAND FISHERIES AND WILDLIFE**  
BGS Project Number 3159

*The project consists of a 16,500 GSF major renovation of a historical brick 3 story building, two additions totaling 27,000 GSF, and a 8,750 GSF detached storage barn. The construction consists of excavation; utilities; paving; landscaping; concrete foundations; glue-lam and cross laminated timber, metal, and concrete structure; unit masonry; cementitious and stone veneer siding; building insulation; doors, frames, and windows; roofing; interior partitions; finishes; electric traction passenger and service elevator; complete fire suppression; mechanical and plumbing; securing access; instructional technology; public address systems; and incidental work and other work indicated in the contract documents.*

The contract shall designate the Substantial Completion Date on or before *April 9, 2027*, and the Contract Final Completion Date on or before *April 30, 2027*.

1. Submit bids on a completed Contractor Bid Form (section 00 41 13), provided in the Bid Documents, include bid security when required, and scan each item as an attachment to an email addressed to: BGS.Architect@Maine.gov, so as to be received no later than **2:00:00 p.m. on March 5, 2025**. The email subject line shall be marked "**Bid for NEW HEADQUARTERS BUILDING - INLAND FISHERIES AND WILDLIFE**".

Bid submissions will be opened and read aloud at the time and date noted above at the Bureau of General Services office, accessible as a video conference call. Those who wish to participate in the call must submit a request for access to BGS.Architect@Maine.gov.

Any bid received after the noted time will not be considered a valid bid and will remain unopened. Any bid submitted by any other means will not be considered a valid bid. In certain circumstances, the Bureau of General Services may require the Bidder to surrender a valid paper copy of the bid form or the bid security document. The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.

2. Questions and comments on the *bid opening process* shall be addressed to: Division of Planning, Design & Construction, Bureau of General Services, 77 State House Station, Augusta, Maine 04333-0077, BGS.Architect@Maine.gov.
3. Questions and comments regarding the *project* design specifications or drawings shall be directed in writing to the Consultant during the bid period prior to the question and comment deadline of 5:00 p.m. on *February 25, 2025*.

*Oak Point Associates  
Attn: IFW HQ Project Team  
IFWHQ@oakpoint.com*

**00 11 13**  
**Notice to Contractors**

4. ☒ Bid security is required on this project.

The Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with the completed bid form submitted to the Owner. The Bid Bond form is available on the BGS website.

5. ☒ Performance and Payment Bonds are required on this project.

If noted above as required, or if any combination of Base Bid and Alternate Bids amounts selected in the award of the contract exceeds \$125,000.00, the selected Contractor shall furnish a 100% contract Performance Bond (section 00 61 13.13) and a 100% contract Payment Bond (section 00 61 13.16) in the contract amount to cover the execution of the Work. Bond forms are available on the BGS website.

6. Filed Sub-bids *are not required* on this project.

7. ☒ Pre-qualified General Contractors are utilized on this project.

*A/Z Corporation  
Consigli  
Landry/French Construction  
Nickerson & O'Day  
PC Construction*

8. A mandatory on-site pre-bid conference ( ☒ *mandatory* ) will be conducted for this project.

The pre-bid conference is intended for General Contractors. Subcontractors and suppliers are welcome to attend. Contractors who arrive late or leave early for a mandatory meeting may be prohibited from participating in this meeting and bidding.

*February 11, 2025 at 2:00 p.m.*

*27 Independence Drive*

*Meeting will begin with a building site walk at the CETA Building followed by a brief meeting at the Marquardt Building, 32 Blossom Lane, Room 118 at 3:00 p.m.*

9. Bid Documents - full sets only - will be available on or about *January 29, 2025* and may be obtained *at cost* from:

*Xpress Copy Services  
17 Westfield Street  
Portland, ME 04102  
orders@xcopy.com*

10. Bid Documents may be examined at:

*AGC Maine  
188 Whitten Road, Augusta, ME 04330  
207-622-4741*

*Construction Summary  
734 Chestnut Street, Manchester, NH 03104  
603-627-8856*

**00 21 13**  
**Instructions to Bidders**

**1. Bidder Requirements**

- 1.1 A bidder is a Contractor which is evidently qualified, or has been specifically pre-qualified by the Bureau of General Services, to bid on the proposed project described in the Bid Documents.
- 1.2 Contractors and Subcontractors bidding on projects that utilize Filed Sub-bids shall follow the requirements outlined in these Bid Documents for such projects. See Section 00 22 13 for additional information.
- 1.3 Contractors and Subcontractors are not eligible to bid on the project when their access to project design documents prior to the bid period distribution of documents creates an unfair bidding advantage. Prohibited access includes consultation with the Owner or with design professionals engaged by the Owner regarding cost estimating, constructability review, or project scheduling. This prohibition to bid applies to open, competitive bidding or pre-qualified contractor bidding or Filed Sub-bidding. The Bureau may require additional information to determine if the activities of a Contractor constitute an unfair bidding advantage.
- 1.4 Each bidder is responsible for becoming thoroughly familiar with the Bid Documents prior to submitting a bid. The failure of a bidder to review evident site conditions, to attend available pre-bid conferences, or to receive, examine, or act on addenda to the Bid Documents shall not relieve that bidder from any obligation with respect to their bid or the execution of the work as a Contractor.
- 1.5 Prior to the award of the contract, General Contractor bidders or Filed Sub-bidders may be required to provide documented evidence to the Owner or the Bureau showing compliance with the provisions of this section, their business experience, financial capability, or performance on previous projects.
- 1.6 The selected General Contractor bidder will be required to provide proof of insurance before a contract can be executed.
- 1.7 Contracts developed from this bid shall not be assigned, sublet or transferred without the written consent of the Owner.
- 1.8 By submitting a bid the Contractor attests that it has not been declared ineligible to bid on State of Maine projects. The Director of the Bureau of General Services may disallow award of this contract to any Contractor if there is evidence that the Contractor or any of its Subcontractors, through their own fault, have been terminated, suspended for cause, debarred from bidding, agreed to refrain from bidding as part of a settlement, have defaulted on a contract, or had a contract completed by another party.
- 1.9 The Contractor attests that it is not presently indicted for or otherwise criminally or civilly charged by a Federal, State or local government entity with commission of any of the following offenses and has not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction, or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.



**00 21 13**  
**Instructions to Bidders**

- 1.10 The Contractor shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs or State of Maine projects.
2. Authority of Owner
  - 2.1 The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.
  - 2.2 Subject to the Owner's stated right to accept or reject any or all bids, the Contractor shall be selected on the basis of the lowest dollar value of an acceptable Base Bid, or any combination of Base Bid plus Alternate Bids, as well as other limited cost modifications the Owner determines may best serve the interests of the Owner. An acceptable bid is a duly submitted bid from a responsive and responsible bidder.
  - 2.3 The Owner reserves the right to require Bid Bonds or Performance and Payment Bonds for any project of any contract value.
3. Submitting Bids and Bid Requirements
  - 3.1 Each bid shall be submitted on the forms provided in the Bid Documents.
  - 3.2 Each bid shall be valid for a period of thirty calendar days following the Project bid closing date and time. The bid expiration date may be extended in unusual circumstances by mutual consent of the Bidder and the Owner. The bid amount shall not be modified due to the bid expiration date extension.
  - 3.3 Any provision contained in a bid which shows cost escalation, or any modification of schedule or other requirements shall not be accepted. Such a provision causes the bid to be invalid, or, at the discretion of the Owner and BGS, that element of the bid submission may be disregarded for the purpose of awarding the contract without that provision.
  - 3.4 Bidders shall include a Bid Bond or other approved bid security with the bid form submitted to the Owner when the bid form indicates such bid security is required. The bond value shall be 5% of the bid amount. The form of bond is shown in section 00 43 13.
  - 3.5 Bidders recognize that inclusion of contract bonds and the cost of those bonds is dependent on the awarded contract dollar value. Therefore, a Base Bid, or any combination of Base Bid plus Alternate Bids, as well as other limited cost modifications, resulting in a contract award shall include the cost of Performance and Payment Bonds in the submitted bid amount when the construction contract value is over \$125,000.00. Similarly, the cost of Performance and Payment Bonds is excluded in the submitted bid amount when the construction contract value is \$125,000.00 or less unless bonds are specifically required by the Bid Documents. When required for the project, the selected Contractor shall provide these bonds before a contract can be executed, pursuant to 14 M.R.S.A., Section 871, Public Works Contractors' Surety Bond Law of 1971, subsection 3. The form of bonds is shown in section 00 61 13.13 and 00 61 13.16.

**00 21 13**  
**Instructions to Bidders**

- 3.6 Bidders may modify bids in writing, by the same means as the original bid submission, prior to the bid closing time. Such written amendments shall not disclose the amount of the initial bid. If so disclosed, the entire bid is considered invalid.
- 3.7 Bidders implicitly acknowledge all Addenda issued when they submit the bid form. By usual practice the Consultant shall not issue Addenda less than 72 hours prior to the bid closing time, to allow ample time for bidders to incorporate the information. However, some information, such as extending the bid due date and time, may be issued with shorter notice. Addenda shall be issued to all companies who are registered holders of Bid Documents.
- 3.8 A bid may be withdrawn without penalty if a written request by the bidder is presented to the Owner prior to the bid closing time. Such written withdrawal requests are subject to verification as required by the Bureau.
- A bid may be withdrawn without penalty after the bid closing time if, in the determination of the Bureau, evidence provided by the Contractor shows an apparent unintended error such as a miscalculation, or an erroneous number on estimating documents, was the cause of an inaccurate bid. The Bureau may allow withdrawal in consideration of the bid bond or, without utilizing a bid bond, if the Bureau considers documented evidence provided by the Contractor shows factual errors had been made on the bid form.
- 3.9 In the event State of Maine Offices unexpectedly close on the published date of a public bid opening in the location of that bid opening, prior to the time of the scheduled deadline, the new deadline for the public bid opening will be the following business day at the originally scheduled hour of the day, at the original location. Official closings are posted on the State of Maine government website.
- 3.10 The Owner may require, in a Notice of Intent to Award letter to the apparent low bidder, a Schedule of Values, Project Schedule, and List of Subcontractors and Suppliers as both a demonstration of capability of the Bidder and as a condition of award.
- 3.11 Projects which require a State of Maine wage determination will include that schedule as part of the Bid Documents. See section 00 73 46, if such rates are required.
- 3.12 Projects which require compliance with the Davis-Bacon Act are subject to the regulations contained the Code for Federal Regulations and the federal wage determination which is made a part of the Bid Documents. See section 00 73 46, if such rates are required.
- 3.13 The Owner is exempt from the payment of Maine State sales and use taxes as provided in 36 M.R.S. §1760 (1). The Contractor and Subcontractors shall not include taxes on exempt items in the construction contract.

NEW HEADQUARTERS BUILDING  
INLAND FISHERIES AND WILDLIFE – EAST CAMPUS  
AUGUSTA, MAINE

DOCUMENT 00 31 26 - EXISTING HAZARDOUS MATERIAL INFORMATION

PART 1 - GENERAL

1.1 EXISTING HAZARDOUS MATERIAL INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for the Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. An existing asbestos report for Project, prepared by ESHA (Environmental Safety & Hygiene Associates), dated December 2023, is available for viewing as appended to this Project Manual.
- C. An existing lead report for Project, prepared by ESHA (Environmental Safety & Hygiene Associates), dated December 2023, is available for viewing as appended to this Project Manual.
- D. An existing PCB (Polychlorinated Biphenyl) information report for Project, prepared by ESHA (Environmental Safety & Hygiene Associates), dated December 2023, is available for viewing as appended to this Project Manual.
- E. Related Requirements:
  - 1. Section 024119 "Selective Demolition" for notification requirements if materials suspected of containing hazardous materials are encountered.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT

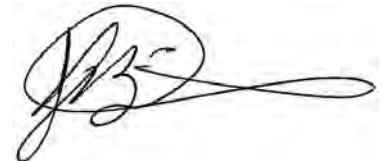
- Indoor Environmental Testing and Consulting
- Industrial Hygiene Consulting
- OSHA Compliance
- Expert Witness
- Training

**HAZARDOUS MATERIALS ASSESSMENT  
ASBESTOS, LEAD-BASED PAINT, PCBS, AND  
UNIVERSAL WASTE  
CETA BUILDING  
27 INDEPENDENCE DRIVE  
AUGUSTA, MAINE**

Prepared for

**MR. TYLER BARTER  
PRINCIPAL/SENIOR ARCHITECT  
OAK POINT ASSOCIATES  
231 Main Street  
Biddeford, ME 04005**

December 2023



John M. Boilard, RIHT, CMC  
Senior Industrial Hygiene &  
Safety Specialist

4 Blanchard Road  
P.O. Box 85A  
Cumberland, Maine 04021  
Phone: 207.854.2711    sme-esh.com

**SME**   
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ENVIRONMENTAL SAFETY  
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**HAZARDOUS MATERIALS ASSESSMENT  
ASBESTOS, LEAD-BASED PAINT, PCB, AND UNIVERSAL WASTE  
CETA BUILDING, 27 INDEPENDENCE DRIVE, AUGUSTA, MAINE**

**1.0 EXECUTIVE SUMMARY**

Sevee & Maher Engineers, Inc./Environmental Safety & Hygiene Associates, LLC (SME/ESHA) was retained by Oak Point Associates to conduct a Hazardous Materials Assessment for Asbestos, Lead-Based Paint, Polychlorinated Biphenyls (PCBs), and Universal Waste Items for interior/exterior areas of the CETA Building situated at 27 Independence Drive in Augusta, Maine for renovation considerations.

The assessment actions were conducted to determine whether any building materials existed for the structure for United States Environmental Protection Agency (U.S.EPA), National Emission Standards for Hazardous Air Pollutants (NESHAP), Maine Department of Environmental Protection (MEDEP), or Occupational Safety and Health Administration (OSHA) compliance issues requiring remedial actions before renovation/demolition activities.

The inspection and assessment actions for asbestos, PCBs, and universal waste were conducted by Mr. John M. Boilard and Mr. Kivvy Spears on November 14, 2023, and lead-based paint testing by XRF was performed by Mr. John M. Boilard on November 21, 2023.

Based on the asbestos inspection, Regulated Asbestos-Containing Materials (RACMs) or Asbestos-Containing Building Materials (ACBMs) were identified in the form of exterior window sash glazing, exterior window caulking, and interior wall panel construction adhesive.

Of note is that several materials were identified as having asbestos content less than 1 percent (< 1%) and though not regulated as an Asbestos-Containing Material (ACM) nor as an asbestos abatement class activity by OSHA, they nevertheless have published guidelines that should be followed for the impact of these materials. Further explanation is provided in Section 3.1 of this report.

XRF testing indicated that all of the window sashes and exterior painted trim work have lead values greater than 1.0 mg/cm<sup>2</sup>, and the first floor has some door trim and window trim (scalloped) with lead values greater than 1.0 mg/cm<sup>2</sup>. In addition to painted surfaces, all of the original sinks and toilets contain lead glazing with levels greater than 1.0 mg/cm<sup>2</sup>.

Screening samples of exterior window glazing and window caulking were collected to determine if the structure had the potential of having PCB-containing glazing and caulking. No PCBs were detected in any of the five (5) screening samples collected (three [3] for window glazing and two [2] for exterior window caulking).

Universal waste items encountered in the building were primarily comprised of fluorescent light bulbs, potential lighting ballasts containing PCBs or Di(2-ethylhexyl) phthalate (DEHP), flood lights, emergency lighting batteries, batteries for fire alarm panel, smoke detectors which may contain americium-241 (Am-241), nickel-63 (Ni-63), or Radium-226 (radium sulfate), mercury thermostats, and four (4) large window A/C units (freon).

## **2.0 INSPECTION METHODOLOGY**

The following summary outlines the methods and standards associated with the collection of physical samples and/or direct surface testing conducted as part of this assessment.

### **2.1 Asbestos Sampling**

The collection of suspect ACBMs was performed in accordance with the MEDEP's Asbestos Management Regulations, Chapter 425, Section 6, Inspection Requirements.

MEDEP's Asbestos Management Regulations, Chapter 425, effective date 4-3-2011, requires analysis of collected samples as follows:

- Surfacing materials, thermal system insulation, and cementitious materials shall be analyzed using the PLM-EPA 600/R-93/116 Visual Estimation Method (1993); and
- Non-friable Organically Bound Materials (NOBs), including but not limited to, floor tiles, asphalt shingles, caulking, glazing, mastics, coatings, sealants, adhesives, and glues shall be analyzed using PLM NOB-EPA 600/R-93/116 with Gravimetric Preparation Method.

Point counting of any samples with asbestos content less than 10 percent was automatically performed.

Sampling was comprised of the collection of homogenous materials as follows:

#### **Surfacing Materials**

- At least three bulk samples from each homogenous area and/or material that is 1,000 square feet or less;
- At least five bulk samples from each homogenous area that is greater than 1,000 square feet, but less than or equal to 5,000 square feet; and
- At least seven bulk samples from each homogenous area that is greater than 5,000 square feet.

#### **Thermal System Insulation**

- Three bulk samples from each homogenous area;

- One bulk sample from each homogenous area of patched thermal system insulation if the patched section is less than 6 linear or square feet; and
- Samples sufficient to determine whether the material is ACBM from each insulated mechanical system where cement is utilized on tees, elbows, or valves.

#### Miscellaneous Materials

- Three samples from each miscellaneous material; and
- One sample if the amount of miscellaneous material is less than 6 square or linear feet.

## 2.2 Lead-Based Paint Testing

Lead-Based Paint (LBP) determination was performed to identify if interior and exterior general painted building surfaces contain lead-based paint for renovation/demolition impact considerations.

The lead-based paint assessment was comprised of testing painted surfaces by direct contact analysis utilizing a portable X-Ray Fluorescence Lead Paint Analyzer (Olympus Vanta C-Series™, Serial # 820237).

The instrument satisfactorily underwent pre- and post-calibration utilizing the manufacturer's reference standard.

The information compiled during this testing is not intended to be substituted for a comprehensive lead-based paint survey, or to be used to express potential exposure to airborne lead for OSHA compliance. The testing provides the client with information on the lead-based paint content in the materials tested.

## 2.3 Polychlorinated Biphenyls (PCBs)

The PCB assessment was comprised of the collection of bulk samples for exterior window glazing and caulking representative of the various types of materials present.

Samples were collected in order to have 1 to 2 grams of material for analysis and QA/QC procedures. Collected samples were placed into 40-millimeter glass Volatile Organic Analyte (VOA) vials with Teflon sealing lids.

Laboratory analysis review indicates that none of the five (5) samples collected contained any PCBs.

A summary table of analysis, associated laboratory chain-of-custody, and analysis data can be found in Appendix F to this document.

Drawings indicating sampling locations can be found in Appendix G of this document.



## 2.4 Universal Waste

This assessment action was performed to identify components and materials containing mercury such as light bulbs and thermostats containing PCBs/DEHP as in lighting system ballast components, as well as other general universal waste materials such as refrigerators, portable air conditioners, rechargeable batteries TVs, computers, and computer monitors, etc.

This assessment was performed to provide information to contractors who may generate waste relating to renovation/demolition activities for compliance with the requirements of MEDEP Chapter 850, Universal Waste Rules.

## **3.0 SUMMARY/RECOMMENDATIONS**

### 3.1 Asbestos Sampling

Bulk samples of suspect materials that were collected during this sampling event consisted of the following:

- Sheetrock
- Joint Compound
- Plasters (walls & ceilings)
- White Coat on walls
- Construction Adhesive
- 2-foot x 4-foot Ceiling Tiles
- Cove Base Adhesive
- Sheet Flooring with jute backing
- 12-inch x 12-inch Floor Tiles
- Faux Subway wall tiling
- Sink Undercoating
- Window Glazing
- Window Caulking
- Roofing Underlayment Paper under slate roof tiles

A total of thirty-two (32) homogeneous sample groups were collected totaling ninety-four (94) samples. Ninety-four (94) samples were analyzed by PLM-Visual Method due to layering of plaster samples,

thirteen (13) samples were analyzed by PLM-NOB Gravimetric Method, seven (7) NOB samples further analyzed by Point Count Method for results less than 10 percent, and two (2) NOB samples prepped but not fully analyzed due to a positive result in a homogeneous group.

Asbestos-containing materials identified by the accredited laboratory can be found in the Summary Table and Laboratory Data information in Appendix B.

ACBMs identified by the above analysis can be found as marked on the drawings found in Appendix C.

Recommendations for identified Asbestos materials are as follows:

**Asbestos Materials >1%:**

The ACBMs found at the site containing greater than or equal to 1 percent ( $\geq 1\%$ ) asbestos content consist of non-friable and potentially friable U.S.EPA Regulated Asbestos Containing Materials (RACM) and U.S.EPA Category II Non-Friable materials in their present states.

Friable materials can be crumbled by hand pressure and readily release asbestos fibers when impacted. Comparatively, non-friable materials do not crumble under hand pressure and do not readily release asbestos fibers to the surrounding atmosphere.

Materials containing equal to or greater than 1 percent ( $\geq 1\%$ ) of asbestos are regulated under the requirements of OSHA 29 CFR 1910.1001 and 29 CFR 1926.1101, U.S.EPA, and MEDEP.

All work operations which would impact ACBMs would need to be in compliance with the asbestos regulations as set forth in OSHA 29 CFR Part 1926.1101; U.S.EPA Title 40 - CFR, Part 61 NESHAP, Subparts A and M (General Provisions and Asbestos Standards, respectively); and MEDEP Regulations, Chapter 425, effective 4-3-2011.

Any removal and/or cleanup of the identified ACBMs would need to be performed by properly trained and/or licensed companies and workers.

The **asbestos-containing window caulking (tan inner layer) and construction adhesive (dark brown)** identified are a potentially friable material (Category II Non-Friable) that if removed without rendering the materials into a friable condition are not regulated by NESHAPS or MEDEP CMR 425. If removed whole and intact, these materials can be removed by properly trained personnel as an OSHA Class II Asbestos Activity and no MEDEP Asbestos Abatement Design Plan or Asbestos Abatement Project Notification permitting and fees would be required. Proper disposal as an asbestos containing material may apply and would be determinant on the accepting landfill operating rules.

In any case, this ACBM is always subject to OSHA regulations for direct impact/handling by personnel. Waste regulations for both U.S.EPA and MEDEP statutes would depend on the disposition of the materials. Category I or Category II Non-Friable ACBM that is not subject to the requirements of 40 CFR Part 61.150(a)(3) would still have to be disposed of in a landfill that accepts building debris, in a landfill that operates in accordance with 40 CFR Part 61.154, or at a facility that operates in accordance with 40 CFR Part 61.155. These renovation/demolition waste materials are not allowed to go to any facility that would sand, grind, cut or abrade the non-RACM waste or otherwise turn it into RACM waste (such as cement recycling facilities).

#### **Asbestos Materials <1%:**

Materials identified at the site containing less than 1 percent (< 1%) asbestos content are comprised of the following types of materials:

Window Glazing (off-white)	PC <0.25% Chrysotile Asbestos
Window Caulking (gray outer layer)	PC <0.25% Chrysotile Asbestos

The OSHA Construction Asbestos Standard, 29 CFR 1926.1101, has outlined requirements that would apply even if neither the OSHA asbestos permissible exposure limit (PEL) of 0.1 fiber per cubic centimeter (f/cc) or the OSHA excursion limit (EL) of 1.0 f/cc are exceeded in a letter on interpretation (November 24, 2003). In this interpretation, OSHA outlines that the asbestos standard contains numerous work practice requirements and prohibitions which apply, regardless of the exposure levels to employees. However, only two of the requirements and three of the prohibitions must be observed in the case of work activities involving installed construction materials that do not contain greater than 1 percent (> 1%) asbestos. Those work practice requirements and prohibitions that must be observed regardless of the exposure levels and of the percentage of asbestos in the installed construction materials are:

- 29 CFR 1926.1101(g)(1)(ii), which requires: **wet methods, or wetting agents, to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup, except where employers demonstrate that the use of wet methods is infeasible due to, for example, the creation of electrical hazards, equipment malfunction, and, in roofing, except as provided in paragraph (g)(8)(ii)<sup>2</sup> of this section;**
- 29 CFR 1926.1101(g)(1)(iii), which requires: **prompt clean-up and disposal of wastes and debris contaminated with asbestos in leak-tight containers except in roofing operations, where the procedures specified in paragraph (g)(8)(ii)<sup>3</sup> of this section apply;**
- 29 CFR 1926.1101(g)(3)(i), which prohibits: **high-speed abrasive disc saws that are not equipped with point-of-cut ventilator or enclosures with HEPA filtered exhaust air;**

- 29 CFR 1926.1101(g)(3)(ii), which prohibits: **compressed air used to remove asbestos, or materials containing asbestos, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air; and**
- 29 CFR 1926.1101(g)(3)(iv), which prohibits: **employee rotation as a means of reducing employee exposure to asbestos.**

There are also some other provisions that apply to work activities involving installed construction materials even where the material does not contain greater than 1 percent (> 1%) asbestos. However, if neither the asbestos PEL or EL limits are exceeded, then only the following few provisions apply:

- 29 CFR 1926.1101(f)(2)(i), the provision for establishing that neither asbestos PEL is exceeded: **Each employer who has a workplace or work operation covered by this standard shall ensure that a "competent person" conducts an exposure assessment immediately before or at the initiation of the operation to ascertain expected exposures during that operation or workplace. The assessment must be completed in time to comply with requirements which are triggered by exposure data or the lack of a "negative exposure assessment," and to provide information necessary to assure that all control systems planned are appropriate for that operation and will work properly;**
- 29 CFR 1926.1101(f)(6)(i), a provision covering the observation of monitoring: **The employer shall provide affected employees and their designated representatives an opportunity to observe any monitoring of employee exposure to asbestos conducted in accordance with this section;**
- 29 CFR 1926.1101(f)(5)(i), a provision covering employee notification of monitoring results: **The employer shall notify affected employees of the monitoring results that represent that employee's exposure as soon as possible following receipt of monitoring results;**
- 29 CFR 1926.1101(f)(5)(ii), another provision covering employee notification of monitoring results: **The employer shall notify affected employees of the results of monitoring representing the employee's exposure in writing either individually or by posting at a centrally located place that is accessible to affected employees; and**
- 29 CFR 1926.1101(n)(2)(i)-(iii), a set of provisions covering recordkeeping for measurements of exposures to airborne asbestos.

### 3.2 Lead-Based Paint Testing

An environmental lead hazard is defined as any paint or surface coating that contains lead in levels equal to or greater than 1.0 milligram per square centimeter (mg/cm<sup>2</sup>).

Lead-Based Paint Screening by XRF was conducted with all testing, whether positive or negative, documented on the attached analysis sheets. Analysis results are indicated in milligrams per square centimeter (mg/cm<sup>2</sup>).

Of note is that the upper detection limit for the XRF unit utilized is 5.0 mg/cm<sup>2</sup>, meaning that surfaces with testing results as 5.0 mg/cm<sup>2</sup> could have lead values greater than those listed.

Samples which contain lead-based paint are highlighted on the attached analysis sheets in Orange.

A total of 162 surface types were tested by XRF with a total of 244 individual test sites analyzed.

Several painted surface types were found to be lead containing with results greater than 1.0 mg/cm<sup>2</sup> and were comprised of window sashes and exterior painted trim work. Other painted components found to have lead value results greater than 1.0 mg/cm<sup>2</sup> are the scalloped window/doorway trim work and door jambs for the first floor areas only.

Other lead-containing items identified were comprised of the original sinks and toilets on all levels of the building with lead containing glazing greater than 1.0 mg/cm<sup>2</sup>.

Refer to the attached analytical results data sheets for XRF testing values (Appendix D) and the marked drawings indicating sampling locations (Appendix E).

### **Recommendations for Lead in Paints**

Disturbance of painted surfaces representatively sampled at the site can create an increased risk for lead exposure to persons performing activities that would abrade or otherwise breakdown the paint and create a potential airborne hazard.

The method of impact for painted surfaces may or may not exceed the OSHA Permissible Exposure Level of 50 µg/m<sup>3</sup> or the Action Level of 30 µg/m<sup>3</sup> by any renovation/demolition actions.

Removed painted architectural materials with well adhered paints can be disposed of in normal construction and demolition debris waste streams. However, these materials should not go off-site as general fill, to a facility that would recycle the materials, or to a facility where the materials would be intentionally burned.

If free paint chips/debris is generated, then the collected material needs to be either disposed of as lead special waste or be tested for lead content to determine the hazard characteristic as a leachate for proper disposal consideration.

The objective of this inspection was to determine the presence of lead-based paint for potential overall renovation/demolition impact and not every surface associated with the structure. The information compiled during this testing is not intended to be substituted for a comprehensive lead-based paint survey, or to be used to express potential occupational exposure to airborne lead for the purposes of OSHA regulatory compliance. All scraping, sanding, cutting, welding, grinding, or demolition of any painted surface should not be performed under dry conditions in which airborne dust can be generated.

Similarly, demolition activities that may impact lead-containing components are a concern with respect to the generation of airborne lead dust; therefore, safety measures such as the use of engineering controls are essential in order to protect human health and the environment.

Contractors performing demolition activities in which excessive amounts of lead dust may potentially be generated shall be trained in the hazards of lead-containing materials and the subsequent control of the impacted environment, removal, cleaning, packaging, and handling of these materials as well as the wearing of NIOSH approved respirators, use of disposable clothing, and other requirements of the standard. All work operations shall be performed in accordance with the following:

- OSHA 29 CFR Part 1926.62, Lead Standard;
- MEDEP Chapter 424, Lead Management Regulations; and
- U.S.EPA Renovation, Repair, & Repainting Rule (RRP), effective April 22, 2010.

### 3.3 Polychlorinated Biphenyls (PCBs)

No recommendations required, as no PCBs were identified at the site for glazing and caulking.

### 3.4 Universal Waste

General comments regarding universal waste items:

#### **Mercury**

Effective as of July 15, 2002, businesses and agencies can no longer dispose of mercury-added products in solid waste facilities (landfills or incinerators).

#### **Thermostats**

Mercury thermostats may be recycled under the Thermostat Recycling Program. This program utilizes the existing wholesaler network by providing a collection container at participating locations. Return any out-of-service mercury thermostats to any participating HVAC wholesaler. Any name-brand mercury switch thermostat will be accepted.

## **Fluorescent Lamps**

No fluorescent lamps are mercury-free.

This includes the new compact type light bulbs (CFLs) and lamps marketed as “low mercury” containing (green ends).

U.S.EPA recommends that any mercury-containing light bulb be recycled or properly handled and disposed properly, whether it is an older type bulb or a newer “low” mercury type bulb.

State of Maine law requires businesses and consumers to recycle all mercury added lamps, including “low” mercury type bulbs (green ends) under the MEDEP Chapter 850, Universal Waste Rules.

## **PCB Ballasts**

Non-leaking PCB ballasts are classified as a special hazardous waste and may be managed under the reduced requirements.

Waste from leaking ballasts is regulated by the Toxic Substances Control Act (TSCA). Regulations require the use of DOT-approved 55-gallon drums for disposal of PCB capacitors once they are removed. Drums should contain absorbent material (speedy-dry or kitty litter) at the bottom in case some of the capacitors are damaged or leaking. There should be a PCB M<sub>L</sub> label placed on each drum that contains PCB capacitors. Drums should be sealed and stored in a secure area that would minimize inadvertent damage or vandalism. Two drums are recommended, one to contain intact capacitors and one to contain any capacitors found to be leaking. This is beneficial because leaking capacitors must be disposed of within 30 days; however, intact capacitors can be stored until the drum is full.

**NOTE:** If one pound or more of PCBs (the amount in 12 to 16 ballasts) is released within 24 hours, notify the National Response Center.

### **Leaking Ballasts**

TSCA Hotline ..... (202) 554-1404

### **Releases of one pound or more**

National Response Center ..... (800) 424-8802

## **Non-PCB Ballasts**

Non-PCB ballasts cannot be disposed of in conventional waste streams. Beginning in 1979 manufacturers began using **di (2-ethylhexyl) phthalate (DEHP)** as a replacement to PCBs. DEHP is listed as a hazardous substance under the U.S.EPA's Superfund regulations. Generators discarding light ballasts should take the same precautions with their DEHP ballasts as they do with their PCB ballasts to avoid any future liabilities.

## **Freon**

Freon-containing items such as refrigerators and air conditioning require that refrigerant must be either recycled before re-charging into your system, destroyed, or reclaimed to a 99.5 percent purity level before re-introduction into another system.

### **Batteries**

Batteries, including Nickel Cadmium, Metal Hydride, small sealed Lead Acid, Lithium, Mercuric Oxide, Zinc Air and Silver Oxide button batteries must be properly recycled.

### **Electronics**

Typical covered electronic devices (CEDs) include, but are not limited to, old CRT tube televisions, liquid-crystal displays (LCDs), organic light-emitting diodes (OLEDs), plasma televisions, and computers, or any other item with circuit boards. These wastes typically contain hazardous constituents and fail hazardous waste criteria if they are tested. Most of these wastes contain heavy metals. These wastes, when broken or incinerated release the metals to the environment through fugitive emissions or from incinerator stacks.

Refer to the attached Universal Waste Drawings for locations, quantities, and types of items identified at the time of this assessment in Appendix H.

## **4.0 LIMITING CONDITIONS**

The observations, conclusions, and recommendations described in this inspection report were made under the conditions stated herein and were arrived at and in accordance with generally accepted standards related to assessment and sampling for hazardous materials. The conclusions presented in the report were based solely upon the services described herein, and not on scientific tasks or procedures beyond the scope of described services.

It is possible that hidden materials in the structure were not representatively sampled, particularly for materials within enclosed walls or ceilings. Some limited explorations for determining conditions under carpeting and if multiple flooring layers were present were conducted until the presumed substrate was reached.

Contractors performing renovation/demolition actions should stop work if materials not representatively sampled as part of this inspection are uncovered, and have the materials properly assessed before further impact.

Hidden or exposed materials during renovations/demolition that may result in possible inaccuracies of information supplied to SME/ESHA by others might have a material bearing on the findings, conclusions, and recommendations. SME/ESHA reserves the right to amend its opinion(s) if additional information becomes available, but SME/ESHA assumes no obligation to do so.

No warranty or guarantee, expressed or implied, is made regarding the findings, conclusions, or recommendations contained in this report. The limitations presented above supersede the requirements or provisions of all other contracts or scopes of work, implied or otherwise, except as expressly stated or



acknowledged herein. SME/ESHA is not responsible for the actions other parties that may be involved in this project.

It is expressly agreed that SME/ESHA will have no liability to any party for reliance upon any of the findings or recommendations contained in this report. To the extent that this provision is found unenforceable by any court, any liability SME/ESHA may have arising out of its agreement with the contracting party is expressly agreed to be limited to the amount paid to SME/ESHA.

## APPENDIX A

### CERTIFICATIONS AND LICENSES





JANET T. MILLS  
GOVERNOR

STATE OF MAINE  
DEPARTMENT OF ENVIRONMENTAL PROTECTION



MELANIE LOYZIM  
COMMISSIONER

September 27, 2023

**Environmental Safety & Hygiene Associates**  
4 Blanchard Road  
Cumberland, Maine 04021

Dear Licensee:

Asbestos application(s) for individual certification of the **two** employee(s) listed below have been received and **approved**. Individual certification numbers are listed below and wallet card(s) are enclosed. Card(s) are property of the individual to whom each is issued. Your responsibility as a licensee is to ensure delivery of the cards to persons in your employment. This letter should be retained for your company files as record of certification. **Please attach 1 updated passport size photo with every application.**

**Remember**, in Maine all **certified employees** working on an asbestos abatement project, whether conducting removal/repair, air monitoring, design, inspection, or analysis functions, **must work for a State of Maine licensed asbestos firm** and carry his/her wallet card(s) on the job site.

As a reminder, prior to renewing your asbestos certification, the State of Maine **requires** an annual refresher course to be taken before submitting a renewal application. A certificate shall expire one year from the last day of the month from the date of issuance, **or on the last day of the month that the training certificate expires**, whichever is sooner.

All our asbestos forms can be found at <https://www.maine.gov/dep/waste/asbestos/forms.html>  
Thank you for your cooperation and your completed application(s).

<u>Name</u>	<u>Category</u>	<u>Certification #</u>	<u>Exp. Date</u>
John M. Boilard	Air Monitor	AM-0037	09/30/2024
John M. Boilard	Inspector	AI-0154	09/30/2024

Sincerely,

Sandra J. Moody, Environmental Specialist  
Division of Remediation  
Bureau of Remediation and Waste Management

AUGUSTA  
17 STATE HOUSE STATION  
AUGUSTA, MAINE 04333-0017  
(207) 287-1688 FAX: (207) 287-7826

BANGOR  
106 HOGAN ROAD, SUITE 4  
BANGOR, MAINE 04401  
(207) 941-4570 FAX: (207) 941-4584

PORTLAND  
512 CANCON ROAD  
PORTLAND, MAINE 04101  
(207) 822-6386 FAX: (207) 822-6365

PRESQUE ISLE  
1295 CENTRAL DRIVE, SKYWAY PARK  
PRESQUE ISLE, MAINE 04769  
(207) 744-0477 FAX: (207) 766-5143

State of Maine  
Asbestos Abatement Program  
**John M. Boilard**  
*Inspector*  
Cert 1: AI-0154  
Trn. Exp. Date 09/22/2024  
*Air Monitor*  
Cert 2: AM-0037  
Trn. Exp. Date 09/22/2024  
Expiration Date 09/30/2024  
This is not a legal form of official identification





JANET T. MILLS  
GOVERNOR

STATE OF MAINE  
DEPARTMENT OF ENVIRONMENTAL PROTECTION



MELANIE LOYZIM  
COMMISSIONER

September 28, 2023

**Environmental Safety & Hygiene Associates**  
4 Blanchard Road  
Cumberland, Maine 04021

Dear Licensee:

Asbestos application(s) for individual certification of the **one** employee(s) listed below have been received and **approved**. Individual certification numbers are listed below and wallet card(s) are enclosed. Card(s) are property of the individual to whom each is issued. Your responsibility as a licensee is to ensure delivery of the cards to persons in your employment. This letter should be **retained for your company files as record of certification.** **Please attach 1 updated passport size photo with every application.**

**Remember**, in Maine all **certified employees** working on an asbestos abatement project, whether conducting removal/repair, air monitoring, design, inspection, or analysis functions, **must work for a State of Maine licensed asbestos firm** and carry his/her wallet card(s) on the job site.

As a reminder, prior to renewing your asbestos certification, the State of Maine **requires** an annual refresher course to be taken before submitting a renewal application. A certificate shall expire one year from the last day of the month from the date of issuance, **or on the last day of the month that the training certificate expires**, whichever is sooner.

All our asbestos forms can be found at <https://www.maine.gov/dep/waste/asbestos/forms.html>  
Thank you for your cooperation and your completed application(s).

<u>Name</u>	<u>Category</u>	<u>Certification #</u>	<u>Exp. Date</u>
Kivvy A. Spears	Inspector	AI-0748	08/31/2024

Sincerely,

Sandra J. Moody, Environmental Specialist  
Division of Remediation  
Bureau of Remediation and Waste Management



AUGUSTA  
17 STATE HOUSE STATION  
AUGUSTA, MAINE 04333-0017  
(207) 287-7600 FAX: (207) 287-7826

BANGOR  
106 HOGAN ROAD, SUITE 6  
BANGOR, MAINE 04401  
(207) 941-4370 FAX: (207) 941-4504

PORTLAND  
312 CANNON ROAD  
PORTLAND, MAINE 04103  
(207) 822-6300 FAX: (207) 822-6303

PRESCOTT ISLAND  
1255 CENTRAL DRIVE, SKYWAY PARK  
PRESCOTT ISLAND, MAINE 04769  
(207) 764-0477 FAX: (207) 760-3143



## APPENDIX B

### ASBESTOS ANALYTICAL SUMMARY TABLES AND LABORATORY DATA

## ASBESTOS BULK SAMPLING ANALYTICAL SUMMARY

**CLIENT:**

Oak Point Associates  
231 Main Street  
Biddeford, ME 04005

**TESTING LOCATION:**

CETA Building  
27 Independence Drive  
Augusta, ME 04330

**SAMPLING DATE:**

November 14, 2023

**PROJECT NUMBER:**

231600.00

**LAB ID:**

622301258

SAMPLE ID:	TESTING AREA/LOCATION	SAMPLE DESCRIPTION	ANALYTICAL METHOD	SAMPLE RESULTS
1A – 1C	Third Floor Hallway	Sheetrock	EPA PLM Visual Estimation Method	None Detected
2A – 2C	Third Floor Bathroom	Horsehair Plaster – Gray White Topcoat “Faux Subway Tile”	EPA PLM Visual Estimation Method	None Detected
3A – 3C	Third Floor Hallway	Joint Compound – White	EPA PLM Visual Estimation Method	None Detected
4A – 4C	Third Floor Hallway	Wall Plaster – Gray with White Topcoat	EPA PLM Visual Estimation Method	None Detected
5A – 5C	Third Floor Room	Sheet Flooring With Jute Backer – Tan	EPA PLM Visual Estimation Method	None Detected
6A – 6C	Third Floor Bathroom	Base Coat Plaster – Gray	EPA PLM Visual Estimation Method	None Detected
7A – 7C	Third Floor Hallway Ceiling	Horsehair Plaster With White Topcoat	EPA PLM Visual Estimation Method	None Detected
8A – 8C	Third Floor	Window Glazing – Off-White	EPA PLM NOB Gravimetric Reduction	None Detected
9A – 9C	Second Floor	12” x 12” Floor Tiles – Red Mottled with Yellow Glue	EPA PLM NOB Gravimetric Reduction	None Detected
10A	Second Floor	Window Glazing – Off-White	EPA PLM NOB 400 Point Count Gravimetric Reduction	PC < 0.25 Chrysotile
10B				PC < 0.25 Chrysotile
10C				PC < 0.25 Chrysotile
11A – 11C	Second Floor Bathroom	Plaster Base Coat – Gray	EPA PLM Visual Estimation Method	None Detected
12A – 12C	Second Floor Bathroom	Topcoat Plaster – White “Faux Subway Tile”	EPA PLM Visual Estimation Method	None Detected
13A – 13C	Second Floor Hallway	Wall Plaster with Topcoat – Gray and White	EPA PLM Visual Estimation Method	None Detected
14A – 14C	Second Floor Hallway	Sheetrock – Gray	EPA PLM Visual Estimation Method	None Detected
15A – 15C	Second Floor Hallway	Joint Compound – Off-White	EPA PLM Visual Estimation Method	None Detected
16A – 16C	Second Floor Stairwell	White Coat on Cement Walls	EPA PLM Visual Estimation Method	None Detected
17A – 17C	Second Floor Room	Ceiling Plaster with White Coat	EPA PLM Visual Estimation Method	None Detected

SAMPLE ID:	TESTING AREA/LOCATION	SAMPLE DESCRIPTION	ANALYTICAL METHOD	SAMPLE RESULTS
18A – 18C	First Floor Hallway	Plaster With White Coat Walls – Gray	EPA PLM Visual Estimation Method	None Detected
19A – 19C	First Floor Hallway	Sheetrock – Gray	EPA PLM Visual Estimation Method	None Detected
20A – 20C	First Floor	2' x 4' Ceiling Tile With Fissures and Pinholes	EPA PLM Visual Estimation Method	None Detected
21A – 21C	First Floor	Ceiling – Plaster With White Coat	EPA PLM Visual Estimation Method	None Detected
22A – 22C	First Floor	Joint Compound – White	EPA PLM Visual Estimation Method	None Detected
23A – 23C	First Floor	Window Glazing – Off-White	EPA PLM NOB Gravimetric Reduction	None Detected
24A	First Floor	Panel Adhesive – Dark Brown	EPA PLM NOB 400 Point Count Gravimetric Reduction	<b>PC 1.6% Chrysotile</b>
24B – 24C				Positive Stop (Not Analyzed)
25A – 25C	First Floor	4" Cove Base Adhesive – Cream	EPA PLM NOB Gravimetric Reduction	None Detected
26A – 26C	Basement	Walls With White Coat	EPA PLM Visual Estimation Method	None Detected
27A – 27C	Basement	Plaster Base – Gray	EPA PLM Visual Estimation Method	None Detected
28A – 28C	Basement	Ceiling Plaster With White Coat	EPA PLM Visual Estimation Method	None Detected
29A	First Floor Exterior	Window Caulking – Tan	EPA PLM NOB Gravimetric Reduction	<b>15.8% Chrysotile</b>
29B – 29C				Positive Stop (Not Analyzed)
30A	First Floor Exterior	Window Caulking – Gray	EPA PLM NOB 400 Point Count Gravimetric Reduction	<b>PC &lt; 0.25 Chrysotile</b>
30B				<b>PC &lt; 0.25 Chrysotile</b>
30C				<b>PC &lt; 0.25 Chrysotile</b>
31A – 31C	Exterior	Roofing Underlayment – Black	EPA PLM Visual Estimation Method	None Detected
32A	Basement Kitchen	Sink Undercoat – Off-White	EPA PLM Visual Estimation Method	None Detected



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<http://www.EMSL.com> / [portlandlab@emsl.com](mailto:portlandlab@emsl.com)

EMSL Order ID: 622301258  
Customer ID: ESHA42  
Customer PO: 231600.00  
Project ID:

**Attn:** John Boilard  
ESHA  
PO Box 85A  
Cumberland, ME 04021

**Phone:**  
**Fax:** (207) 829-5692  
**Collected:** 11/14/2023  
**Received:** 11/15/2023  
**Analyzed:** 11/22/2023

**Proj:** 231600 CETA BLDG

## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 1A **Lab Sample ID:** 622301258-0001

**Sample Description:** SHEETROCK, GRAY - Sheetrock

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray/Tan	10.0%	90.0%	None Detected	

**Client Sample ID:** 1B **Lab Sample ID:** 622301258-0002

**Sample Description:** SHEETROCK, GRAY - Sheetrock

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 1C **Lab Sample ID:** 622301258-0003

**Sample Description:** SHEETROCK, GRAY - Sheetrock

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray/Tan	15.0%	85.0%	None Detected	

**Client Sample ID:** 2A-Skim Coat **Lab Sample ID:** 622301258-0004

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 2A-Base Coat **Lab Sample ID:** 622301258-0004A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 2B-Skim Coat **Lab Sample ID:** 622301258-0005

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 2B-Base Coat **Lab Sample ID:** 622301258-0005A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	





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EMSL Order ID: 622301258  
Customer ID: ESHA42  
Customer PO: 231600.00  
Project ID:

## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 2C-Skim Coat **Lab Sample ID:** 622301258-0006

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 2C-Base Coat **Lab Sample ID:** 622301258-0006A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 3A **Lab Sample ID:** 622301258-0007

**Sample Description:** JOINT COMPOUND, WHITE - Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 3B **Lab Sample ID:** 622301258-0008

**Sample Description:** JOINT COMPOUND, WHITE - Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 3C **Lab Sample ID:** 622301258-0009

**Sample Description:** JOINT COMPOUND, WHITE - Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 4A-Skim Coat **Lab Sample ID:** 622301258-0010

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASE COAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Tan/White	0.0%	100.0%	None Detected	

**Client Sample ID:** 4A-Base Coat **Lab Sample ID:** 622301258-0010A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASE COAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 4B-Skim Coat **Lab Sample ID:** 622301258-0011

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASE COAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Tan/White	0.0%	100.0%	None Detected	



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EMSL Order ID: 622301258  
Customer ID: ESHA42  
Customer PO: 231600.00  
Project ID:

## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 4B-Base Coat **Lab Sample ID:** 622301258-0011A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASE COAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 4C-Skim Coat **Lab Sample ID:** 622301258-0012

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASE COAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Tan/White	0.0%	100.0%	None Detected	

**Client Sample ID:** 4C-Base Coat **Lab Sample ID:** 622301258-0012A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASE COAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 5A **Lab Sample ID:** 622301258-0013

**Sample Description:** SHEETFLOOR, TAN

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Tan	6.0%	94.0%	None Detected	

**Client Sample ID:** 5B **Lab Sample ID:** 622301258-0014

**Sample Description:** SHEETFLOOR, TAN

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Tan	8.0%	92.0%	None Detected	

**Client Sample ID:** 5C **Lab Sample ID:** 622301258-0015

**Sample Description:** SHEETFLOOR, TAN

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Tan	8.0%	92.0%	None Detected	

**Client Sample ID:** 6A **Lab Sample ID:** 622301258-0016

**Sample Description:** PLASTER, BASE COAT GRAY - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 6B **Lab Sample ID:** 622301258-0017

**Sample Description:** PLASTER, BASE COAT GRAY - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	



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EMSL Order ID: 622301258  
Customer ID: ESHA42  
Customer PO: 231600.00  
Project ID:

## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 6C **Lab Sample ID:** 622301258-0018

**Sample Description:** PLASTER, BASE COAT GRAY - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 7A-Skim Coat **Lab Sample ID:** 622301258-0019

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Tan/White	0.0%	100.0%	None Detected	

**Client Sample ID:** 7A-Base Coat **Lab Sample ID:** 622301258-0019A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 7B-Skim Coat **Lab Sample ID:** 622301258-0020

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Tan/White	0.0%	100.0%	None Detected	

**Client Sample ID:** 7B-Base Coat **Lab Sample ID:** 622301258-0020A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 7C-Skim Coat **Lab Sample ID:** 622301258-0021

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Tan/White	0.0%	100.0%	None Detected	

**Client Sample ID:** 7C-Base Coat **Lab Sample ID:** 622301258-0021A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 8A **Lab Sample ID:** 622301258-0022

**Sample Description:** WINDOW GLAZING, OFF-WHITE - Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	White	0.0%	100%	None Detected	



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EMSL Order ID: 622301258  
Customer ID: ESHA42  
Customer PO: 231600.00  
Project ID:

## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 8B **Lab Sample ID:** 622301258-0023

**Sample Description:** WINDOW GLAZING, OFF-WHITE - Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	White	0.0%	100%	None Detected	

**Client Sample ID:** 8C **Lab Sample ID:** 622301258-0024

**Sample Description:** WINDOW GLAZING, OFF-WHITE - Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	White	0.0%	100%	None Detected	

**Client Sample ID:** 9A **Lab Sample ID:** 622301258-0025

**Sample Description:** 12" FLOOR TILE, RED MOTTLED - Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	Red	0.0%	100%	None Detected	

**Client Sample ID:** 9B **Lab Sample ID:** 622301258-0026

**Sample Description:** 12" FLOOR TILE, RED MOTTLED - Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	Red	0.0%	100%	None Detected	

**Client Sample ID:** 9C **Lab Sample ID:** 622301258-0027

**Sample Description:** 12" FLOOR TILE, RED MOTTLED - Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	Red	0.0%	100%	None Detected	

**Client Sample ID:** 10A **Lab Sample ID:** 622301258-0028

**Sample Description:** WINDOW GLAZING, OFF-WHITE - Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
400 PLM PtCt Grav. Red.	11/22/2023	White	2.5%	97.5%	<0.25% Chrysotile	

**Client Sample ID:** 10B **Lab Sample ID:** 622301258-0029

**Sample Description:** WINDOW GLAZING, OFF-WHITE - Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
400 PLM PtCt Grav. Red.	11/22/2023	White	0.0%	100%	<0.25% Chrysotile	

**Client Sample ID:** 10C **Lab Sample ID:** 622301258-0030

**Sample Description:** WINDOW GLAZING, OFF-WHITE - Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
400 PLM PtCt Grav. Red.	11/22/2023	White	0.0%	100%	<0.25% Chrysotile	



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EMSL Order ID: 622301258  
Customer ID: ESHA42  
Customer PO: 231600.00  
Project ID:

## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 11A **Lab Sample ID:** 622301258-0031

**Sample Description:** PLASTER, BASE COAT, GRAY - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	4.0%	96.0%	None Detected	

**Client Sample ID:** 11B **Lab Sample ID:** 622301258-0032

**Sample Description:** PLASTER, BASE COAT, GRAY - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	4.0%	96.0%	None Detected	

**Client Sample ID:** 11C **Lab Sample ID:** 622301258-0033

**Sample Description:** PLASTER, BASE COAT, GRAY - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	4.0%	96.0%	None Detected	

**Client Sample ID:** 12A **Lab Sample ID:** 622301258-0034

**Sample Description:** PLASTER, TOP COAT, WHITE - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 12B **Lab Sample ID:** 622301258-0035

**Sample Description:** PLASTER, TOP COAT, WHITE - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 12C **Lab Sample ID:** 622301258-0036

**Sample Description:** PLASTER, TOP COAT, WHITE - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 13A-Skim Coat **Lab Sample ID:** 622301258-0037

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 13A-Base Coat **Lab Sample ID:** 622301258-0037A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	4.0%	96.0%	None Detected	



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161 John Roberts Road South Portland, ME 04106  
Phone/Fax: (207) 517-6921 / (207) 517-6922  
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EMSL Order ID: 622301258  
Customer ID: ESHA42  
Customer PO: 231600.00  
Project ID:

## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 13B-Skim Coat **Lab Sample ID:** 622301258-0038

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 13B-Base Coat **Lab Sample ID:** 622301258-0038A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	3.0%	97.0%	None Detected	

**Client Sample ID:** 13C-Skim Coat **Lab Sample ID:** 622301258-0039

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 13C-Base Coat **Lab Sample ID:** 622301258-0039A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray	4.0%	96.0%	None Detected	

**Client Sample ID:** 14A **Lab Sample ID:** 622301258-0040

**Sample Description:** SHEETROCK, GRAY - Sheetrock

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray/Tan	13.0%	87.0%	None Detected	

**Client Sample ID:** 14B **Lab Sample ID:** 622301258-0041

**Sample Description:** SHEETROCK, GRAY - Sheetrock

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray/Tan	10.0%	90.0%	None Detected	

**Client Sample ID:** 14C **Lab Sample ID:** 622301258-0042

**Sample Description:** SHEETROCK, GRAY - Sheetrock

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	Gray/Tan	10.0%	90.0%	None Detected	

**Client Sample ID:** 15A **Lab Sample ID:** 622301258-0043

**Sample Description:** JOINT COMPOUND, WHITE - Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	4.0%	96.0%	None Detected	



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Project ID:

## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 15B **Lab Sample ID:** 622301258-0044

**Sample Description:** JOINT COMPOUND, WHITE - Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	4.0%	96.0%	None Detected	

**Client Sample ID:** 15C **Lab Sample ID:** 622301258-0045

**Sample Description:** JOINT COMPOUND, WHITE - Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/20/2023	White	4.0%	96.0%	None Detected	

**Client Sample ID:** 16A **Lab Sample ID:** 622301258-0046

**Sample Description:** WHITE COAT (OLD CEMENT) - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 16B **Lab Sample ID:** 622301258-0047

**Sample Description:** WHITE COAT (OLD CEMENT) - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 16C **Lab Sample ID:** 622301258-0048

**Sample Description:** WHITE COAT (OLD CEMENT) - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White/Green	0.0%	100.0%	None Detected	

**Client Sample ID:** 17A-Skim Coat **Lab Sample ID:** 622301258-0049

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 17A-Base Coat **Lab Sample ID:** 622301258-0049A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 17B-Skim Coat **Lab Sample ID:** 622301258-0050

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	



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## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 17B-Base Coat **Lab Sample ID:** 622301258-0050A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 17C-Skim Coat **Lab Sample ID:** 622301258-0051

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 17C-Base Coat **Lab Sample ID:** 622301258-0051A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 18A-Skim Coat **Lab Sample ID:** 622301258-0052

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 18A-Base Coat **Lab Sample ID:** 622301258-0052A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 18B-Skim Coat **Lab Sample ID:** 622301258-0053

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 18B-Base Coat **Lab Sample ID:** 622301258-0053A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 18C-Skim Coat **Lab Sample ID:** 622301258-0054

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	





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## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 18C-Base Coat **Lab Sample ID:** 622301258-0054A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 19A **Lab Sample ID:** 622301258-0055

**Sample Description:** SHEETROCK, GRAY - Sheetrock

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray/Tan	6.0%	94.0%	None Detected	

**Client Sample ID:** 19B **Lab Sample ID:** 622301258-0056

**Sample Description:** SHEETROCK, GRAY - Sheetrock

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray/Tan	6.0%	94.0%	None Detected	

**Client Sample ID:** 19C **Lab Sample ID:** 622301258-0057

**Sample Description:** SHEETROCK, GRAY - Sheetrock

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray/Tan	3.0%	97.0%	None Detected	

**Client Sample ID:** 20A **Lab Sample ID:** 622301258-0058

**Sample Description:** CEILING TILE, FISSURE AND PINHOLES - Ceiling Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray/White	60.0%	40.0%	None Detected	

**Client Sample ID:** 20B **Lab Sample ID:** 622301258-0059

**Sample Description:** CEILING TILE, FISSURE AND PINHOLES - Ceiling Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray/White	60.0%	40.0%	None Detected	

**Client Sample ID:** 20C **Lab Sample ID:** 622301258-0060

**Sample Description:** CEILING TILE, FISSURE AND PINHOLES - Ceiling Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray/White	60.0%	40.0%	None Detected	

**Client Sample ID:** 21A-Skim Coat **Lab Sample ID:** 622301258-0061

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	



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## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 21A-Base Coat **Lab Sample ID:** 622301258-0061A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	4.0%	96.0%	None Detected	

**Client Sample ID:** 21B-Skim Coat **Lab Sample ID:** 622301258-0062

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 21B-Base Coat **Lab Sample ID:** 622301258-0062A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	3.0%	97.0%	None Detected	

**Client Sample ID:** 21C-Skim Coat **Lab Sample ID:** 622301258-0063

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 21C-Base Coat **Lab Sample ID:** 622301258-0063A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	3.0%	97.0%	None Detected	

**Client Sample ID:** 22A **Lab Sample ID:** 622301258-0064

**Sample Description:** JOINT COMPOUND, WHITE - Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 22B **Lab Sample ID:** 622301258-0065

**Sample Description:** JOINT COMPOUND, WHITE - Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 22C **Lab Sample ID:** 622301258-0066

**Sample Description:** JOINT COMPOUND, WHITE - Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	



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Project ID:

## Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: 23A Lab Sample ID: 622301258-0067

Sample Description: WINDOW GLAZING, OFF-WHITE - Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	White	0.0%	100%	None Detected	

Client Sample ID: 23B Lab Sample ID: 622301258-0068

Sample Description: WINDOW GLAZING, OFF-WHITE - Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	White	0.0%	100%	None Detected	

Client Sample ID: 23C Lab Sample ID: 622301258-0069

Sample Description: WINDOW GLAZING, OFF-WHITE - Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	White	0.0%	100%	None Detected	

Client Sample ID: 24A Lab Sample ID: 622301258-0070

Sample Description: PANEL ADHESIVE, DARK BROWN - Adhesive

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
400 PLM PtCt Grav. Red.	11/22/2023	Brown	0.0%	98.4%	1.6% Chrysotile	

Client Sample ID: 24B Lab Sample ID: 622301258-0071

Sample Description: PANEL ADHESIVE, DARK BROWN - Adhesive

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
400 PLM PtCt Grav. Red.	11/22/2023				Positive Stop (Not Analyzed)	

Client Sample ID: 24C Lab Sample ID: 622301258-0072

Sample Description: PANEL ADHESIVE, DARK BROWN - Adhesive

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
400 PLM PtCt Grav. Red.	11/22/2023				Positive Stop (Not Analyzed)	

Client Sample ID: 25A Lab Sample ID: 622301258-0073

Sample Description: COVE BASE ADHESIVE, CREAM - Adhesive

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	Beige	0.0%	100%	None Detected	

Client Sample ID: 25B Lab Sample ID: 622301258-0074

Sample Description: COVE BASE ADHESIVE, CREAM - Adhesive

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	Beige	0.0%	100%	None Detected	



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## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 25C **Lab Sample ID:** 622301258-0075

**Sample Description:** COVE BASE ADHESIVE, CREAM - Adhesive

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	Beige	0.0%	100%	None Detected	

**Client Sample ID:** 26A **Lab Sample ID:** 622301258-0076

**Sample Description:** WHITE COAT, WALLS - Plaster Skim Coat

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 26B **Lab Sample ID:** 622301258-0077

**Sample Description:** WHITE COAT, WALLS - Plaster Skim Coat

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 26C **Lab Sample ID:** 622301258-0078

**Sample Description:** WHITE COAT, WALLS - Plaster Skim Coat

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 27A **Lab Sample ID:** 622301258-0079

**Sample Description:** GRAY BASE COAT (PLASTER) - Plaster Base Coat

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 27B **Lab Sample ID:** 622301258-0080

**Sample Description:** GRAY BASE COAT (PLASTER) - Plaster Base Coat

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 27C **Lab Sample ID:** 622301258-0081

**Sample Description:** GRAY BASE COAT (PLASTER) - Plaster Base Coat

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	0.0%	100.0%	None Detected	

**Client Sample ID:** 28A-Skim Coat **Lab Sample ID:** 622301258-0082

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	



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## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 28A-Base Coat **Lab Sample ID:** 622301258-0082A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	4.0%	96.0%	None Detected	

**Client Sample ID:** 28B-Skim Coat **Lab Sample ID:** 622301258-0083

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 28B-Base Coat **Lab Sample ID:** 622301258-0083A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	4.0%	96.0%	None Detected	

**Client Sample ID:** 28C-Skim Coat **Lab Sample ID:** 622301258-0084

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	White	0.0%	100.0%	None Detected	

**Client Sample ID:** 28C-Base Coat **Lab Sample ID:** 622301258-0084A

**Sample Description:** PLASTER, WHITE TOP COAT/GRAY BASECOAT - Plaster

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Gray	4.0%	96.0%	None Detected	

**Client Sample ID:** 29A **Lab Sample ID:** 622301258-0085

**Sample Description:** WINDOW CAULKING, TAN (BASE) - Caulk

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023	Tan	0.0%	84.2%	15.8% Chrysotile	

**Client Sample ID:** 29B **Lab Sample ID:** 622301258-0086

**Sample Description:** WINDOW CAULKING, TAN (BASE) - Caulk

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023				Positive Stop (Not Analyzed)	

**Client Sample ID:** 29C **Lab Sample ID:** 622301258-0087

**Sample Description:** WINDOW CAULKING, TAN (BASE) - Caulk

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	11/22/2023				Positive Stop (Not Analyzed)	



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## Summary Test Report for Asbestos Analysis of Bulk Material

**Client Sample ID:** 30A **Lab Sample ID:** 622301258-0088

**Sample Description:** WINDOW CAULKING, GRAY (TOP) - Caulk

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
400 PLM PtCt Grav. Red.	11/22/2023	Gray	2.4%	97.6%	<0.25% Chrysotile	

**Client Sample ID:** 30B **Lab Sample ID:** 622301258-0089

**Sample Description:** WINDOW CAULKING, GRAY (TOP) - Caulk

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
400 PLM PtCt Grav. Red.	11/22/2023	Gray	0.0%	100%	<0.25% Chrysotile	

**Client Sample ID:** 30C **Lab Sample ID:** 622301258-0090

**Sample Description:** WINDOW CAULKING, GRAY (TOP) - Caulk

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
400 PLM PtCt Grav. Red.	11/22/2023	Gray	0.0%	100%	<0.25% Chrysotile	

**Client Sample ID:** 31A **Lab Sample ID:** 622301258-0091

**Sample Description:** SLATE ROOF UNDERLAYMENT, BLACK - Roof Underlayment

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Black	40.0%	60.0%	None Detected	

**Client Sample ID:** 31B **Lab Sample ID:** 622301258-0092

**Sample Description:** SLATE ROOF UNDERLAYMENT, BLACK - Roof Underlayment

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Black	40.0%	60.0%	None Detected	

**Client Sample ID:** 31C **Lab Sample ID:** 622301258-0093

**Sample Description:** SLATE ROOF UNDERLAYMENT, BLACK - Roof Underlayment

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/21/2023	Black	40.0%	60.0%	None Detected	

**Client Sample ID:** 32A **Lab Sample ID:** 622301258-0094

**Sample Description:** SINK UNDERCOATING, OFF-WHITE - Sink Underlayment

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	11/22/2023	Gray/White	0.0%	100.0%	None Detected	



## EMSL Analytical, Inc.

161 John Roberts Road South Portland, ME 04106  
Phone/Fax: (207) 517-6921 / (207) 517-6922  
<http://www.EMSL.com> / [portlandlab@emsl.com](mailto:portlandlab@emsl.com)

EMSL Order ID: 622301258  
Customer ID: ESHA42  
Customer PO: 231600.00  
Project ID:

### Summary Test Report for Asbestos Analysis of Bulk Material

PLM: ME CERT # BA-0233

PLM 400 PC - Gravimetric: ME CERT # BA-0178

PLM EPA NOB: ME CERT # BA-0233

#### Analyst(s):

Stefan Reis	PLM (94) 400 PLM PtCt Grav. Red (3) PLM Grav. Reduction (13)
Stephen Severn	400 PLM PtCt Grav. Red (4)

#### Reviewed and approved by:

Stephen Severn, Technical Manager  
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This is a summary report; official reports are available on LabConnect or upon request and relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. South Portland, ME NVLAP Lab Code 500094-0, VT AL197271, ME LM-0039, CT PH-0346, AZ AZ-0959, MA AA000236

Initial report from: 11/22/2023 16:47:00



EMSL ANALYTICAL, INC.  
LABORATORY PRODUCTS TRAINING

## Asbestos Chain of Custody

EMSL Order Number (lab use only):

622301258

EMSL Analytical, Inc.  
200 Route 130 North

Cinnaminson, NJ 08077

PHONE: 1-800-220-3675

FAX: (856) 786-5974

Company Name : ESHA (Sevee & Maher Engineers)		EMSL Customer ID: ESHA 42	
Street: PO Box 85A		City: Cumberland	State or Province: ME
Zip/Postal Code: 04021	Country: US	Telephone #: 207-829-5016	Fax #: 207-829-5692
Report To (Name): John Boilard		Please Provide Results via: <input type="checkbox"/> Fax <input checked="" type="checkbox"/> Email	
email Address: analytical.eshdata@sme-engineers.com		Purchase Order Number: 231600.00	
Client Project ID: 231600 CETA Bldg.		EMSL Project ID (internal use only):	
State or Province Collected: ME		CT only <input type="checkbox"/> Commercial/Taxable <input type="checkbox"/> Residential/Tax Exempt	
EMSL-Bill to: <input checked="" type="checkbox"/> Same <input type="checkbox"/> Different - If bill to is different note instructions in comment. Third party billing requires written authorization from third party			
Turnaround Time (TAT) Options Please Check			
<input type="checkbox"/> 3 Hr <sup>1</sup>	<input type="checkbox"/> 4-4.5Hr <sup>1</sup> <small>AHERA Only</small>	<input type="checkbox"/> 6 Hr <sup>1</sup>	<input type="checkbox"/> 24 Hr
<input type="checkbox"/> 32 Hr <sup>2</sup>	<input type="checkbox"/> 48 Hr	<input type="checkbox"/> 72 Hr	<input type="checkbox"/> 96 Hr
<input checked="" type="checkbox"/> 1 Week	<input type="checkbox"/> 2 Week		
<sup>1</sup> Premium Service Charge applies for 3 Hour TEM AHERA or EPA Level II TAT - you will be asked to sign an authorization form. TEM Air 3-6 Hour, please call ahead to schedule <sup>2</sup> 32 Hour TAT available for select tests only; samples must be submitted by 11:30 am.			
<b>PCM - Air</b> <input type="checkbox"/> NIOSH 7400 <input type="checkbox"/> w/ OSHA 8hr. TWA <b>PLM - Bulk (reporting limit)</b> <input checked="" type="checkbox"/> PLM EPA 600/R-93/116 (<1%) <input checked="" type="checkbox"/> PLM EPA NOB (<1%) <b>Point Count</b> <input checked="" type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1000 (<0.1%) <b>Point Count w/Gravimetric</b> <input checked="" type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1000 (<0.1%) <input type="checkbox"/> NYS 198.1 (friable - NY) <input type="checkbox"/> NYS 198.6 NOB (non-friable-NY) <input type="checkbox"/> NYS 198.8 SOF-V <input type="checkbox"/> NIOSH 9002 (<1%)		<b>TEM - Air<sup>1</sup></b> <input type="checkbox"/> AHERA 40 CFR, Part 763 <input type="checkbox"/> NIOSH 7402 <input type="checkbox"/> EPA Level II <input type="checkbox"/> ISO 10312 <b>TEM - Bulk</b> <input type="checkbox"/> TEM EPA NOB <input type="checkbox"/> NYS NOB 198.4 (non-friable-NY) <input type="checkbox"/> TEM EPA 600/R-93/116 with milling prep (<0.1%)* <b>TEM - Water: EPA 100.2</b> Fibers >10µm <input type="checkbox"/> Waste <input type="checkbox"/> Drinking All Fiber Sizes <input type="checkbox"/> Waste <input type="checkbox"/> Drinking	
		<b>TEM- Settled Dust</b> <input type="checkbox"/> Microvac - ASTM D 5755 <input type="checkbox"/> Wipe - ASTM D6480 <input type="checkbox"/> Carpet Sonication (EPA 600/J-93/167) <b>Soil - Rock - Vermiculite (reporting limit)</b> <input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.25%) <input type="checkbox"/> TEM EPA 600/R-93/116 with milling prep (<0.1%)* <input type="checkbox"/> TEM Qualitative via Filtration Prep <input type="checkbox"/> TEM Qualitative via Drop Mount Prep <input type="checkbox"/> Cincinnati Method EPA 600/R-04/004 - PLM/TEM *Lower reporting limits available on request <b>Other test (please specify):</b>	
<input checked="" type="checkbox"/> Stop At First Positive (clearly identify homogenous areas below)		Filter Pore Size (Air Samples): <input type="checkbox"/> 0.8µm <input type="checkbox"/> 0.45µm	
Sampler's Name:		Sampler's Signature:	
Sample #	Sample Description/Location	Volume, Area or Homogenous Area	Date/Time Sampled
1 A,B,C	SKETROCK, GRAY		11-14-2023
2 A,B,C	PLASTER, WHITE TOP COAT/GRAY BASE COAT		
3 A,B,C	JOINT COMPOUND, WHITE		
4 A,B,C	PLASTER, WHITE TOP COAT/GRAY BASE COAT		
5 A,B,C	SHEET FLOOR, TAN		
Client Sample # (s): 1 A,B,C - 32A		Total # of Samples:	94
Relinquished by (Client):		Date: 11-15-2023	Time: 0820
Received by (Lab):		Date: 11/15/23	Time: 0830
Comments/Special Instructions:			
Send Invoices To: accountspayable@smemaine.com			

RECEIVED

NOV 15 2023

Controlled Document - COC-05 Asbestos - R12.1 - 11/01/2019

EMSL Analytical, Inc.'s (DBA: LA Testing) Laboratory Terms and Conditions are incorporated into this chain of custody by reference in their entirety. Submission of samples to EMSL Analytical Inc. constitutes acceptance and acknowledgment of all terms and conditions.

Page 1 of 3 pages



EMSL ANALYTICAL, INC.  
LABORATORY • PRODUCTS • TRAINING
**Asbestos Chain of Custody** Project Number 231600  
**EMSL Order Number** (Lab Use Only):
PHONE:  
FAX:

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Sample #	Sample Description	Volume/Area (Air) HA # (Bulk)	Date/Time Sampled
6 A, B, C	PLASTER, BASE COAT GRAY		11-14-2023
7 A, B, C	PLASTER, WHITE TOP COAT / GRAY BASE COAT		
8 A, B, C	WINDOW GLAZING, OFF WHITE		
9 A, B, C	12" FLOOR TILE, RED MOTTLED		
10 A, B, C	WINDOW GLAZING, OFF-WHITE		
11 A, B, C	PLASTER, BASE COAT, GRAY		
12 A, B, C	PLASTER, TOP COAT, WHITE		
13 A, B, C	PLASTER, WHITE TOP COAT / GRAY BASE COAT		
14 A, B, C	SHEET ROCK, GRAY		
15 A, B, C	JOINT COMPOUND, WHITE		
16 A, B, C	WHITE COAT (ON CEMENT)		
17 A, B, C	PLASTER, WHITE TOP COAT / GRAY BASE COAT		
18 A, B, C	PLASTER, WHITE TOP COAT / GRAY BASE COAT		
19 A, B, C	SHEET ROCK, GRAY		
20 A, B, C	CEILING TILE, FISSURE & PINHOLES		
21 A, B, C	PLASTER, WHITE TOP COAT / GRAY BASE COAT		
22 A, B, C	JOINT COMPOUND, WHITE		
23 A, B, C	WINDOW GLAZING, OFF WHITE		
24 A, B, C	PANEL ADHESIVE, DARK BROWN		
25 A, B, C	COU2 BASE ADHESIVE, CREAM		
26 A, B, C	WHITE COAT - WALLS (KLEENEX)		
27 A, B, C	GRAY BASE COAT (PLASTER)		
28 A, B, C	PLASTER, WHITE TOP COAT / GRAY BASE COAT		11-14-2023

\*Comments/Special Instructions:

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Page 2 of 3 pages

NOV 15 2023

BY: AS



*Additional Pages of the Chain of Custody are only necessary if needed for additional sample information*

Sample #	Sample Description	Volume/Area (Air) HA # (Bulk)	Date/Time Sampled
29 A,B,C	WINDOW CAULKING, TAN (BASE)	}	11-14-2023
30 A,B,C	WINDOW CAULKING, GRAY (TOP)		↓
31 A,B,C	SLATE ROOF UNDERLAYMENT, BLACK		
32 A	SINK UNDER COATING, OFF-WHITE		
<div></div>			

\*Comments/Special Instructions:

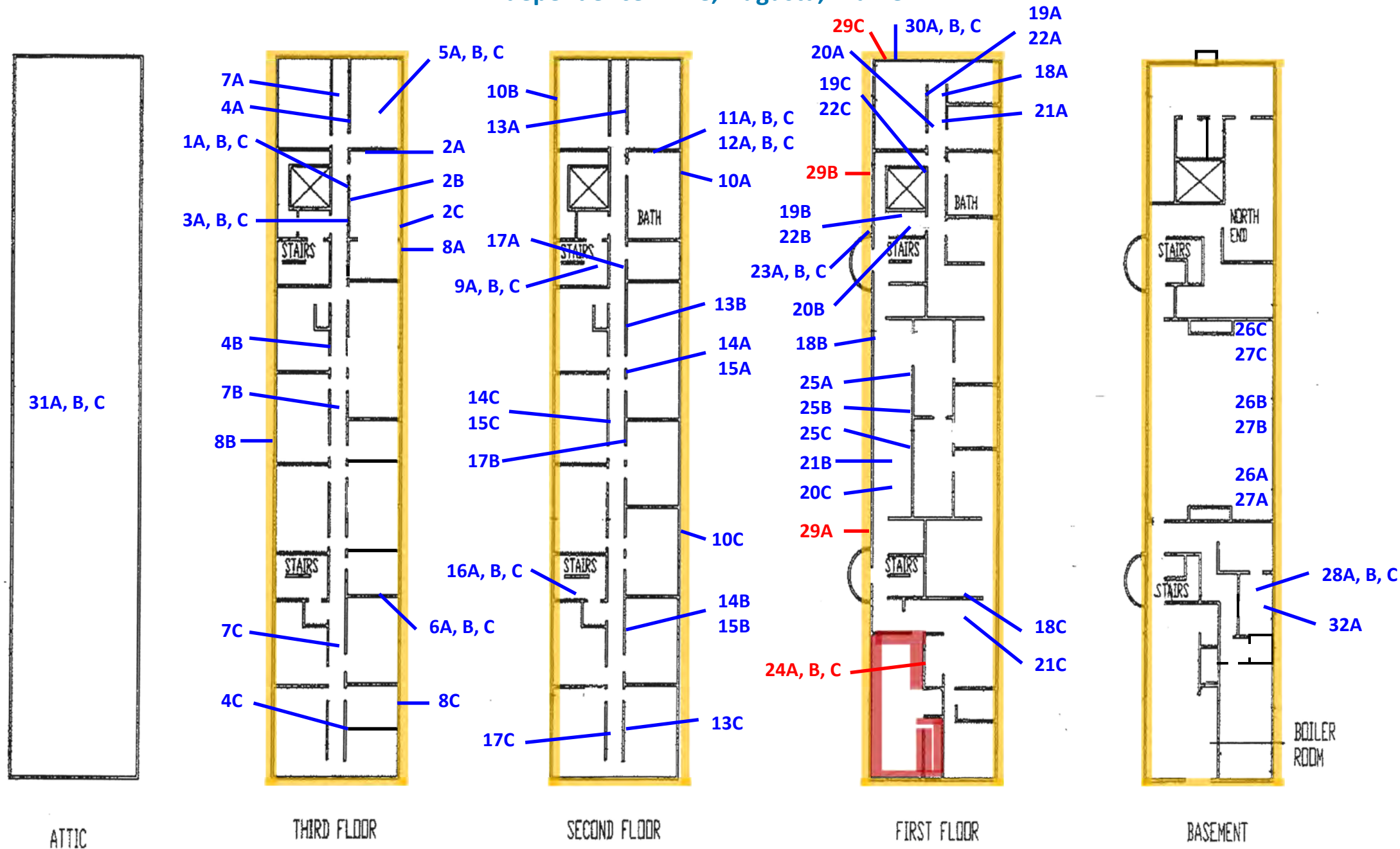
## APPENDIX C

### ASBESTOS SURVEY DRAWINGS

# BUILDING MATERIAL ASSESSMENT for ASBESTOS

## CETA BUILDING

27 Independence Drive, Augusta, Maine



### KEY:

- |    |   |  |
|----|---|--|
| 1A | BULK SAMPLE POSITIVE for ASBESTOS $\geq 1\%$      | ASBESTOS BROWN PANELING ADHESIVE   |
| 1A | BULK SAMPLE with ASBESTOS detected $<1\%$         | ASBESTOS WINDOW CAULKING<br>(Exterior: Base Layer- Tan, Wood to Masonry) |
| 1A | BULK SAMPLE NEGATIVE for ASBESTOS (NONE DETECTED) |  |



SME/ESHA JOB # 231600  
SAMPLING DATE: 11-14-2023

## APPENDIX D

### LEAD-BASED PAINT TESTING DATA AND EQUIPMENT CALIBRATION



# **XRF ANALYSIS SUMMARY** (FOR LEAD BASED PAINT)

**CLIENT:**

Oak Point Associates  
231 Main Street  
Biddeford, ME 04005

**TESTING LOCATION:**

CETA Building  
27 Independence Drive  
Augusta, ME 04330

**SAMPLING DATE:**

November 21, 2023

**PROJECT NUMBER:**

231600.00

**XRF UNIT:** Olympus Vanta C-Series

**SERIAL #:** 820237

SAMPLE ID:	TESTING AREA/LOCATION DESCRIPTION	COLOR	CONDITION (GOOD/FAIR/POOR)	NUMBER OF READINGS	RESULTS (mg/cm <sup>2</sup> )
L-1	Second Floor, Room #203 Wall	White	Poor	2	< 0.3
L-2	Second Floor, Room #203 Wall	White Over Light Green	Poor	2	< 0.3
L-3	Second Floor, Room #203 Wall	White Over Salmon	Poor	2	< 0.3
L-4	Second Floor, Room #203 Base Board	White	Good	3	< 0.3
L-5	Second Floor, Room #205 Window	White	Poor	2	< 0.3
L-6	Second Floor, Room #203 Window Sash	White	Poor	2	1.98
L-7	Second Floor, Room #203 Door Varnish	Brown	Good	1	< 0.3
L-8	Second Floor, Room #204 Wall	White	Poor	3	< 0.3
L-9	Second Floor, Room #204 Crown Molding	White	Good	2	< 0.3
L-10	Second Floor, Room #204 Window Sash	White	Poor	2	5.0
L-11	Second Floor, Main Hallway Wall	White Over Tan	Poor	2	< 0.3
L-12	Second Floor, Room #205 Men's Room	White Over Light Blue/ Light Green / Taupe	Poor	2	< 0.3
L-13	Second Floor, Main Hallway Crown Molding	White	Good	2	< 0.3
L-14	Second Floor, Stairwell Walls	White	Poor	2	< 0.3
L-15	Second Floor, Stairwell Door Trim	White Over Cream	Fair	2	< 0.3
L-16	Second Floor, Room #208/#210 Wall	White	Poor	2	< 0.3
L-17	Second Floor, Room #208/#210 Window Sash	White	Poor	2	2.19
L-18	Second Floor, Room #211/#213 Wall	White Over Tan	Poor	2	< 0.3
L-19	Second Floor, Room #211/#213 Window Sash	White	Poor	2	0.76 – 5.0
L-20	Second Floor, Room #211/#213 Base Board	White	Good	2	< 0.3
L-21	Second Floor, Room #211/#213 Upper Wall	Light Green	Good	2	< 0.3
L-22	Second Floor, Room #212/#214 Varnished Door	Brown	Good	1	< 0.3
L-23	Second Floor, Room #212/#214 Walls	White Over Light Blue	Fair	2	< 0.3

Pre-Use Calibration Reading: 1.074 mg/cm<sup>2</sup>

Post-Use Calibration Reading: 1.049 mg/cm<sup>2</sup>

≥ 1.0 mg/cm<sup>2</sup>

- Lead Containing Material

SAMPLE ID:	TESTING AREA/LOCATION DESCRIPTION	COLOR	CONDITION (GOOD/FAIR/POOR)	NUMBER OF READINGS	RESULTS (mg/cm <sup>2</sup> )
L-24	Second Floor, Room #212/#214 Window Sash	White	Poor	2	5.0
L-25	Second Floor, Room #212/#214 Ceiling	White	Good	2	< 0.3
L-26	Second Floor, Room #212/#214 Radiator	Silver	Fair	2	< 0.3
L-27	Second Floor, Room #215/#217 Walls	White Over Tan/Yellow	Poor	3	< 0.3
L-28	Second Floor, Room #215/#217 Window Sash	White	Poor	2	5.0
L-29	Second Floor, Room #215/#217 Radiator	White	Good	2	< 0.3
L-30	Second Floor, Room #216/#218 Walls	White Over Tan	Poor	2	< 0.3
L-31	Second Floor, Room #216/#218 Radiator	Silver	Good	1	< 0.3
L-32	Second Floor, Room #216/#218 Base Board	White	Good	2	< 0.3
L-33	Second Floor, Room #225 Walls	White Over Orange/Light Green	Poor	3	< 0.3
L-34	Second Floor, Room #224 Window Sash	White	Poor	2	1.2 – 5.0
L-35	Second Floor, Women's Room Wash Sinks	White	Good	2	5.0
L-36	Second Floor, Women's Room Mop Sink	White	Good	1	5.0
L-37	Second Floor, Women's Room Toilet	White	Poor	2	< 0.3
L-38	Second Floor, Room #222 Walls	White	Poor	2	< 0.3
L-39	Second Floor, Room #222 Crown Molding	White	Good	2	< 0.3
L-40	Second Floor, Room #222 Ceiling	White	Good	1	< 0.3
L-41	Second Floor, Room #205 Men's Room	White	Good	2	< 0.3
L-42	Second Floor, Room #205 Mop Sink	White	Good	1	5.0
L-43	Second Floor, Room #205 New Toilet	White	Good	1	< 0.3
L-44	Second Floor, Room #205 Old Toilet	White	Good	1	5.0
L-45	Third Floor, South Stairwell Walls	White	Poor	2	< 0.3
L-46	Third Floor, Main Hallway Wall	White Over Tan	Poor	2	< 0.3
L-47	Third Floor, Main Hallway Ceiling	White	Good	2	< 0.3
L-48	Third Floor, Main Hallway Crown Molding	White	Good	2	< 0.3
L-49	Third Floor, Room #301 Walls	White Over Light Green	Poor	1	< 0.3
L-50	Third Floor, Room #301 Base Board	White	Good	1	< 0.3
L-51	Third Floor, Room #301 Window Sashes	White	Poor	2	5.0
L-52	Third Floor, Room #304 Door Trim	White Over Tan	Poor	2	< 0.3
L-53	Third Floor, Room #304 Walls	White	Poor	2	< 0.3
L-54	Third Floor, Room #304 Radiator	Silver	Fair	1	< 0.3
L-55	Third Floor, Men's Room Mop Sink	White	Good	1	5.0
L-56	Third Floor, Men's Room New Sinks	White	Good	1	< 0.3
L-57	Third Floor, Men's Room Old Toilet	White	Good	1	5.0

Pre-Use Calibration Reading: 1.074 mg/cm<sup>2</sup>Post-Use Calibration Reading: 1.049 mg/cm<sup>2</sup>

$\geq 1.0 \text{ mg/cm}^2$

- Lead Containing Material

SAMPLE ID:	TESTING AREA/LOCATION DESCRIPTION	COLOR	CONDITION (GOOD/FAIR/POOR)	NUMBER OF READINGS	RESULTS (mg/cm <sup>2</sup> )
L-58	Third Floor, Men's Room Window Sashes	White	Poor	1	5.0
L-59	Third Floor, South Stairwell Walls	White Over Green/Tan	Poor	2	< 0.3
L-60	Third Floor, Room #307 Walls	White Over Tan	Fair	1	< 0.3
L-61	Third Floor, Room #307 Base Board	White	Good	1	< 0.3
L-62	Third Floor, Room #307 Door Trim	White Over Tan	Poor	1	< 0.3
L-63	Third Floor, Room #307 Window Sash	White	Poor	2	5.0
L-64	Third Floor, Room #309/#311 Walls	White Over Tan/Yellow	Poor	3	< 0.3
L-65	Third Floor, Room #309/#311 Door Trim	White Over Tan	Poor	1	< 0.3
L-66	Third Floor, Room #309/#311 Ceiling	White	Fair	1	< 0.3
L-67	Third Floor, Room #308/#310 Walls	White Over Tan	Poor	2	< 0.3
L-68	Third Floor, Room #308/#310 Window Sash	White	Poor	1	5.0
L-69	Third Floor, Room #312/#314 Walls	White Over Peach	Fair	2	< 0.3
L-70	Third Floor, Room #312/#314 Radiator	Silver	Good	1	< 0.3
L-71	Third Floor, Room #312/#314 Base Board	White	Good	1	< 0.3
L-72	Third Floor, Room #317 Walls	White Over Light Blue	Poor	1	< 0.3
L-73	Third Floor, Room #317 Varnished Door	Brown	Good	1	< 0.3
L-74	Third Floor, Room #316/#318 Walls	White Over Light Blue/Tan	Poor	2	< 0.3
L-75	Third Floor, Room #316/#318 Upper Wall	Light Green	Good	1	< 0.3
L-76	Third Floor, Room #316/#318 Crown Molding	White	Good	1	< 0.3
L-77	Third Floor, Room #316/#318 Ceiling	White	Good	1	< 0.3
L-78	Third Floor, North Stairwell Walls	White Over Green	Poor	1	< 0.3
L-79	Third Floor, Storage Room Window Sash	White	Poor	1	5.0
L-80	Third Floor, Room #322/#324 Walls	White Over Peach	Fair	1	< 0.3
L-81	Third Floor, Room #322/#324 Window Sash	White	Poor	1	5.0
L-82	Third Floor, Main Hallway Walls	White Over Tan	Poor	1	< 0.3
L-83	Third Floor, Main Hallway Ceiling	White	Fair	1	< 0.3
L-84	Third Floor, Room #325/#327 Walls	White Over Tan/Pink	Poor	2	< 0.3
L-85	Third Floor, Room #325/#327 Ceiling	White	Good	1	< 0.3
L-86	Third Floor, Room #325/#327 Crown Molding	White	Good	1	< 0.3
L-87	Third Floor, North Restroom Mop Sink	White	Good	1	5.0
L-88	Third Floor, North Restroom New Sinks	White	Good	1	< 0.3

Pre-Use Calibration Reading: 1.074 mg/cm<sup>2</sup>Post-Use Calibration Reading: 1.049 mg/cm<sup>2</sup>≥ 1.0 mg/cm<sup>2</sup>

- Lead Containing Material



SAMPLE ID:	TESTING AREA/LOCATION DESCRIPTION	COLOR	CONDITION (GOOD/FAIR/POOR)	NUMBER OF READINGS	RESULTS (mg/cm <sup>2</sup> )
L-89	Third Floor, North Restroom Old Toilets	White	Good	2	5.0
L-90	Third Floor, North Restroom Walls	White Over Light Blue	Fair	2	< 0.3
L-91	First Floor, Southwest Executive Office, Paneled Room Walls	White	Fair	2	< 0.3
L-92	First Floor, Southwest Executive Office, Bookcases	Brown	Poor	2	< 0.3
L-93	First Floor, Southwest Executive Office, Restroom Sink	White	Good	1	< 0.3
L-94	First Floor, Southwest Executive Office, Restroom Toilet	White	Good	1	< 0.3
L-95	First Floor, Southwest Executive Office, Closet Wall	White	Good	2	< 0.3
L-96	First Floor, Office #107, Scalloped Window Trim	White	Fair	2	1.25 – 1.7
L-97	First Floor, Office #107, Scalloped Door Trim	White	Poor	2	1.25 – 1.7
L-98	First Floor, Office #107 Walls	White Over Tan	Poor	2	< 0.3
L-99	First Floor, Restroom #103 Walls	White Over Cream	Poor	1	< 0.3
L-100	First Floor, Restroom #103 Toilet	White	Good	1	< 0.3
L-101	First Floor, Restroom #103 Sink	White	Good	1	< 0.3
L-102	First Floor, Room #101 Walls	White Over Tan	Poor	1	< 0.3
L-103	First Floor, Room #101 Window Sash	White	Poor	1	5.0
L-104	First Floor, Room #101 Radiator	Silver	Good	1	< 0.3
L-105	First Floor, Room #109 Walls	White	Poor	1	< 0.3
L-106	First Floor, Room #109 Door Trim	White	Good	2	1.25 – 1.7
L-107	First Floor, Room #109 Scalloped Window Trim	White	Good	2	1.25 – 1.7
L-108	First Floor, Office Walls	White	Good	1	< 0.3
L-109	First Floor, Office Walls	White	Good	1	< 0.3
L-110	First Floor, Office Walls	White	Good	2	< 0.3
L-111	First Floor, Office Walls	White Over Gray	Good	2	< 0.3
L-112	First Floor, Office Base Board	White	Good	1	< 0.3
L-113	First Floor, Hallway Wall	White Over Yellow	Good	1	< 0.3
L-114	First Floor, Office Walls	White	Good	2	< 0.3
L-115	First Floor, Scalloped Window Trim	White	Fair	3	1.25 – 1.7
L-116	First Floor, Office Walls	White Over Tan	Poor	1	< 0.3
L-117	First Floor, Restroom #113 Varnished Door	Brown	Good	1	< 0.3
L-118	First Floor, Restroom #113 Walls	White Over Green/Peach	Fair	2	< 0.3
L-119	First Floor, Restroom #113 Window Sash	White	Poor	1	5.0
L-120	First Floor, Restroom #113 New Sinks	White	Good	1	< 0.3

Pre-Use Calibration Reading: 1.074 mg/cm<sup>2</sup>≥ 1.0 mg/cm<sup>2</sup>

- Lead Containing Material

Post-Use Calibration Reading: 1.049 mg/cm<sup>2</sup>

SAMPLE ID:	TESTING AREA/LOCATION DESCRIPTION	COLOR	CONDITION (GOOD/FAIR/POOR)	NUMBER OF READINGS	RESULTS (mg/cm <sup>2</sup> )
L-121	First Floor, Restroom #113 New Toilets	White	Good	1	< 0.3
L-122	First Floor, Restroom #113 Mop Sink	White	Good	1	5.0
L-123	First Floor, Room #115 Wall	White Over Tan	Poor	1	< 0.3
L-124	First Floor, Room #115 Door Trim	White Over Tan	Fair	1	< 0.3
L-125	First Floor, Room #117 Window Sashes	White	Poor	1	5.0
L-126	First Floor, Hallway Wall	White Over Yellow	Fair	1	< 0.3
L-127	First Floor, Room #114/#116 Walls	White Over Tan	Poor	1	< 0.3
L-128	First Floor, Room #114/#116 Window Sashes	White	Poor	1	5.0
L-129	First Floor, North Stairwell Wall	White Over Tan	Poor	2	< 0.3
L-130	Basement, Boiler Room Door	White	Good	1	< 0.3
L-131	Basement, Boiler Room Ceiling	Gray	Poor	1	< 0.3
L-132	Basement, South Stairwell Walls	White Over Green	Poor	1	< 0.3
L-133	Basement, Hallway Walls	White	Poor	1	< 0.3
L-134	Basement, Kitchen Wall	White Over Red	Poor	1	< 0.3
L-135	Basement, Kitchen Window Sash	White	Poor	1	5.0
L-136	Basement, Kitchen Floor	Gray	Poor	1	< 0.3
L-137	Basement, Restroom Toilet	White	Good	1	< 0.3
L-138	Basement, Restroom Sink	White	Good	1	< 0.3
L-139	Basement, Storage Room Wall	White	Poor	2	< 0.3
L-140	Basement, Large Room Floor	Gray	Poor	1	< 0.3
L-141	Basement, Large Room Ceiling	White	Poor	1	< 0.3
L-142	Basement, Large Room Walls	White	Poor	1	< 0.3
L-143	Basement, Large Room Window Sashes	White	Poor	1	5.0
L-144	Basement, Large Room Varnished Cabinets	Brown	Fair	1	< 0.3
L-145	Basement, North Stairwell Walls	White Over Green	Poor	2	< 0.3
L-146	Basement, North Stairwell Ceiling	White	Poor	2	< 0.3
L-147	Basement, Hallway Restroom Walls	White	Poor	1	< 0.3
L-148	Basement, Hallway Restroom Ceiling	White	Poor	1	< 0.3
L-149	Basement, Janitor's Room Walls	White	Fair	1	< 0.3
L-150	Basement, Janitor's Room Floor	Gray	Poor	1	< 0.3
L-151	Basement, Janitor's Room Ceiling	White	Good	1	< 0.3
L-152	Basement, Janitor's Room Window Sashes	White	Poor	1	5.0
L-153	Basement, North Storage Room Walls	White	Poor	1	< 0.3
L-154	Basement, North Storage Room Window Sash	White	Poor	1	5.0
L-155	Basement, North Storage Room Walls	White	Poor	1	< 0.3

Pre-Use Calibration Reading: 1.074 mg/cm<sup>2</sup>≥ 1.0 mg/cm<sup>2</sup>

- Lead Containing Material

Post-Use Calibration Reading: 1.049 mg/cm<sup>2</sup>

SAMPLE ID:	TESTING AREA/LOCATION DESCRIPTION	COLOR	CONDITION (GOOD/FAIR/POOR)	NUMBER OF READINGS	RESULTS (mg/cm <sup>2</sup> )
L-156	Basement, North Storage Room Ceiling	White	Poor	1	< 0.3
L-157	Basement, North Storage Room Walls	White	Poor	1	< 0.3
L-158	Basement, Elevator Hydraulic Room Walls	White	Good	1	< 0.3
L-159	Basement, Elevator Hydraulic Room Floor	Gray	Good	1	< 0.3
L-160	Basement, Elevator Hydraulic Room Ceiling	White	Good	1	< 0.3
L-161	Exterior Entry Columns	White	Poor	3	5.0
L-162	Exterior Window Trim	White	Poor	6	1.55 – 5.0

Pre-Use Calibration Reading: 1.074 mg/cm<sup>2</sup>Post-Use Calibration Reading: 1.049 mg/cm<sup>2</sup>

$\geq 1.0 \text{ mg/cm}^2$

- Lead Containing Material



# INSTRUMENT CALIBRATION REPORT



**Pine Environmental Services LLC**

29 Washington Avenue, Unit A  
Scarborough, ME 04074  
Toll-free: (888) 779-PINE (7463)

## Pine Environmental Services, Inc.

**Instrument ID** 46959  
**Description** OLYMPUS VANTA C-SERIES  
**Calibrated** 11/17/2023 8:43:20AM

**Manufacturer** Olympus  
**Model Number** VANTA C SERIES  
**Serial Number/ Lot Number** 820237  
**Location** Maine  
**Department**

**State Certified**  
**Status** Pass  
**Temp °C** 21  
**Humidity %** 31

### Calibration Specifications

**Group #** 1  
**Group Name** System Check  
**Stated Accy**

**Range Acc %** 0.0000  
**Reading Acc %** 0.0000  
**Plus/Minus** 0.00

<u>Nom In Val / In Val</u>	<u>In Type</u>	<u>Out Val</u>	<u>Out Type</u>	<u>Fnd As</u>	<u>Lft As</u>	<u>Dev%</u>	<u>Pass/Fail</u>
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### Test Instruments Used During the Calibration

(As Of Cal Entry Date)

<u>Test Standard ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model Number</u>	<u>Serial Number / Lot Number</u>	<u>Next Cal Date / Last Cal Date/ Expiration Date</u>	<u>Opened Date</u>
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### Notes about this calibration

**Calibration Result** Calibration Successful  
**Who Calibrated** Matthew Rocchio

All instruments are calibrated by Pine Environmental Services LLC according to the manufacturer's specifications, but it is the customer's responsibility to calibrate and maintain this unit in accordance with the manufacturer's specifications and/or the customer's own specific needs.

**Notify Pine Environmental Services LLC of any defect within 24 hours of receipt of equipment**  
**Please call 800-301-9663 for Technical Assistance**



# National Institute of Standards & Technology

## Certificate of Analysis

### Standard Reference Material® 2573

#### Lead Paint Film

For Portable X-Ray Fluorescence Analyzers – Nominal  $1.0 \text{ mg/cm}^2$   
(Color Code: Red)

This Standard Reference Material (SRM) is intended for checking the calibration of portable, hand-held, x-ray fluorescence analyzers when testing for lead in paint coatings on interior and exterior building surfaces. A unit of SRM 2573 consists of a white polyester sheet, approximately 7.6 cm wide, 10.2 cm long, and 0.2 mm thick, coated with a single, red-colored paint layer, approximately 0.04 mm thick. A blank, SRM 2570, is also provided. The blank is coated with a lead-free, lacquer layer on a white polyester sheet of the same thickness as the lead paint samples. All sheets are over-coated with a clear, thin, plastic laminate to protect the surface from abrasion. SRM 2573 and SRM 2570 are two of a set of six paint films (SRM 2570 to SRM 2575) available as SRM 2579a.

The certified values for lead for this SRM and the blank, SRM 2570, are reported in Table 1 in units of  $\text{mg/cm}^2$ . These values are based on measurements by isotope dilution inductively-coupled plasma mass spectrometry.

Table 1. Certified Lead Values

Level	Color Code	Lead Concentration, in $\text{mg/cm}^2$
SRM 2570	White (Blank)	<0.001
SRM 2573	Red	$1.040 \pm 0.064$

The uncertainty of each certified value is expressed as an expanded uncertainty,  $U$ , at the 95 % level of confidence and is calculated according to the method described in the ISO Guide [1,2]. Because of variability in the paint film between different sheets of each SRM, the uncertainties are 95 % prediction intervals. The expanded uncertainty is calculated as  $U = ku_c$ , where  $u_c$  is intended to represent, at the level of one standard deviation, the combined uncertainty due to material variability and measurement uncertainty. The coverage factor,  $k$ , is determined from the Student's  $t$ -distribution corresponding to the calculated effective degrees of freedom and 95 % level of confidence.

**Expiration of Certification:** The certification of SRM 2573 is valid, within the measurement uncertainties specified, until **01 July 2020**, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Use"). The certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

**Maintenance of SRM Certification:** NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

The overall direction and coordination of the analytical measurements leading to certification were performed by G.C. Turk and J.D. Fassett of the NIST Analytical Chemistry Division. Analytical measurements were performed by K.E. Murphy, J.R. Sieber, A.F. Marlow, L.J. Wood, P.R. Seo, and M. Lankosz of the NIST Analytical Chemistry Division. The SRM was fabricated under the direction of J.R. Sieber of the NIST Analytical Chemistry Division.

Stephen A. Wise, Chief  
Analytical Chemistry Division

Robert L. Watters, Jr., Chief  
Measurement Services Division

Gaithersburg, MD 20899  
Certificate Issue Date: 24 March 2009  
See Certificate Revision History on Last Page

Statistical consultation for this SRM was provided by E.S. Lagergren and N.F. Zhang of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Measurement Services Division.

## NOTICE AND WARNING TO USERS

**NOTE:** This SRM contains lead, as a lead chromate pigment, which is toxic and a suspected carcinogen to the lung and kidney. The SRM must be handled with care and disposed of according to the U.S. Environmental Protection Agency (EPA) practices and procedures.

## INSTRUCTIONS FOR USE

The SRM sheet must first be removed from the plastic sleeve in which it is stored and then positioned so that the side labeled with the NIST logo and SRM number faces the x-ray source. For best results, the size of the x-ray beam from the field unit should irradiate an area of the SRM that is at least 2.5 cm in diameter and is centered on the sheet. Care must be exercised not to compromise the protective plastic laminate which prevents scratching or chipping of the painted surface and the potential release of dust containing lead. Upon completion of the measurement, the SRM must be re-stored in the plastic sleeve provided. It is also recommended that this SRM be stored indoors at ambient room temperature and away from direct sunlight when not in use.

**Stability:** This SRM is considered to be stable during the period of certification. NIST will monitor the SRM and will report any significant changes in certification to the purchaser. Return of the attached registration card will facilitate notification.

## PREPARATION

**SRM Preparation:** The paint-coated, polyester sheets were prepared by an automated coating process at a commercial facility under contract to NIST. Known concentrations of a lead chromate pigment were dispersed in a commercial paint vehicle to prepare the lead paints. A lead-free, organic tint was added to each paint mixture to give the desired color. A thin, protective overlay of plastic laminate was applied to each paint film. The attenuation of lead  $L_{3-M_{4,5}}$  ( $L\alpha_{1,2}$ ) X-rays due to the protective overlay does not exceed 2 % relative, while that of  $K-L_{2,3}$  ( $K\alpha_{1,2}$ ) x-rays commonly used for field measurement is negligible.

## REFERENCES

- [1] ISO; *Guide to the Expression of Uncertainty in Measurement*; ISBN 92-67-10188-9, 1st ed., International Organization for Standardization: Geneva, Switzerland (1993); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297, U.S. Government Printing Office: Washington, DC (1994); available at <http://physics.nist.gov/Pubs/>.
- [2] Hahn, G.J.; Meeker, W.Q.; *Statistical Intervals: A Guide for Practitioners*; John Wiley & Sons, Inc., New York, NY (1991).

**Certificate Revision History:** 24 March 2009 (Extension of certification period); 29 November 1999 (Original certificate date).

*Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-2200; fax (301) 926-4751; e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet at <http://www.nist.gov/srm>.*





# Certificate of Analysis

## Standard Reference Material<sup>®</sup> 2570

### Lead Paint Film For Portable X-Ray Fluorescence Analyzers – Blank (Color Code: White)

This Standard Reference Material (SRM) is intended as a blank for SRM 2571 to SRM 2576, which are used for checking the calibration of portable, hand-held, x-ray fluorescence analyzers when testing for lead in paint coatings on interior and exterior building surfaces. A unit of SRM 2570 consists of a white polyester sheet, approximately 7.6 cm wide, 10.2 cm long, and 0.2 mm thick, coated with a single, lacquer layer, approximately 0.04 mm thick. Each unit is over-coated with a clear, thin, plastic laminate to protect the surface from abrasion. SRM 2570 is one of a set of six paint films (SRM 2570 to SRM 2575) available as SRM 2579a.

The certified values for lead for this SRM are reported in Table 1 in units of mg/cm<sup>2</sup>. These values are based on measurements by isotope dilution inductively-coupled plasma mass spectrometry.

Table 1. Certified Lead Values

Level	Color Code	Lead Concentration, in mg/cm <sup>2</sup>
SRM 2570	White (Blank)	<0.001

The uncertainty of each certified value is expressed as an expanded uncertainty,  $U$ , at the 95 % level of confidence and is calculated according to the method described in the ISO Guide [1,2]. Because of variability in the paint film between different sheets of each SRM, the uncertainties are 95 % prediction intervals. The expanded uncertainty is calculated as  $U = ku_c$ , where  $u_c$  is intended to represent, at the level of one standard deviation, the combined uncertainty due to material variability and measurement uncertainty. The coverage factor,  $k$ , is determined from the Student's  $t$ -distribution corresponding to the calculated effective degrees of freedom and 95 % level of confidence.

**Expiration of Certification:** The certification of SRM 2570 is valid, within the measurement uncertainties specified, until **01 July 2020**, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Use"). The certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

**Maintenance of SRM Certification:** NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

The overall direction and coordination of the analytical measurements leading to certification were performed by G.C. Turk and J.D. Fassett of the NIST Analytical Chemistry Division. Analytical measurements were performed by K.E. Murphy, J.R. Sieber, A.F. Marlow, L.J. Wood, P.R. Seo, and M. Lankosz of the NIST Analytical Chemistry Division. The SRM was fabricated under the direction of J.R. Sieber of the NIST Analytical Chemistry Division.

Stephen A. Wise, Chief  
Analytical Chemistry Division

Robert L. Watters, Jr., Chief  
Measurement Services Division

Gaithersburg, MD 20899  
Certificate Issue Date: 24 March 2009  
*See Certificate Revision History on Last Page*

Statistical consultation for this SRM was provided by E.S. Lagergren and N.F. Zhang of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Measurement Services Division.

## NOTICE AND WARNING TO USERS

**NOTE:** While SRM 2570 does not contain any detectable lead, others in this series do contain lead, as a lead chromate pigment, which is toxic and a suspected carcinogen to the lung and kidney. The SRM must be handled with care and disposed of according to the U.S. Environmental Protection Agency (EPA) practices and procedures.

## INSTRUCTIONS FOR USE

The SRM sheet must first be removed from the plastic sleeve in which it is stored and then positioned so that the side labeled with the NIST logo and SRM number faces the x-ray source. For best results, the size of the x-ray beam from the field unit should irradiate an area of the SRM that is at least 2.5 cm in diameter and is centered on the sheet. Care must be exercised not to compromise the protective plastic laminate which prevents scratching or chipping of the painted surface and the potential release of dust containing lead. Upon completion of the measurement, the SRM must be re-stored in the plastic sleeve provided. It is also recommended that this SRM be stored indoors at ambient room temperature and away from direct sunlight when not in use.

## PREPARATION

**SRM Preparation:** The paint-coated, polyester sheets were prepared by an automated coating process at a commercial facility under contract to NIST. The blank level sheets were coated with a clear, lead-free lacquer layer. A thin, protective overlay of plastic laminate was applied to each paint film. The attenuation of lead  $L_{3-M_{4,5}}$  ( $L\alpha_{1,2}$ ) x-rays due to the protective overlay does not exceed 2 % relative, while that of K- $L_{2,3}$  ( $K\alpha_{1,2}$ ) x-rays commonly used for field measurement is negligible.

## REFERENCES

- [1] ISO; *Guide to the Expression of Uncertainty in Measurement*; ISBN 92-67-10188-9, 1st ed., International Organization for Standardization: Geneva, Switzerland (1993); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297, U.S. Government Printing Office: Washington, DC (1994); available at <http://physics.nist.gov/Pubs/>.
- [2] Hahn, G.J.; Meeker, W.Q.; *Statistical Intervals: A Guide for Practitioners*; John Wiley & Sons, Inc., New York, NY (1991).

**Certificate Revision History:** 24 March 2009 (Extension of certification period); 29 November 1999 (Original certificate date).

*Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-2200; fax (301) 926-4751; e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet at <http://www.nist.gov/srm>.*



## APPENDIX E

### LEAD-BASED PAINT TESTING DRAWINGS

LEAD-BASED PAINT DETERMINATION by XRF  
CETA BUILDING  
27 Independence Drive, Augusta, Maine



ATTIC



**KEY:**

**L-#** PAINT TESTING LOCATION with LEAD < 0.3 mg/cm<sup>2</sup> by XRF  
INDICATING NO PRESENCE of LEAD

**L-#** PAINT TESTING LOCATION with LEAD > 1.0 mg/cm<sup>2</sup> by XRF  
INDICATING PRESENCE of LEAD



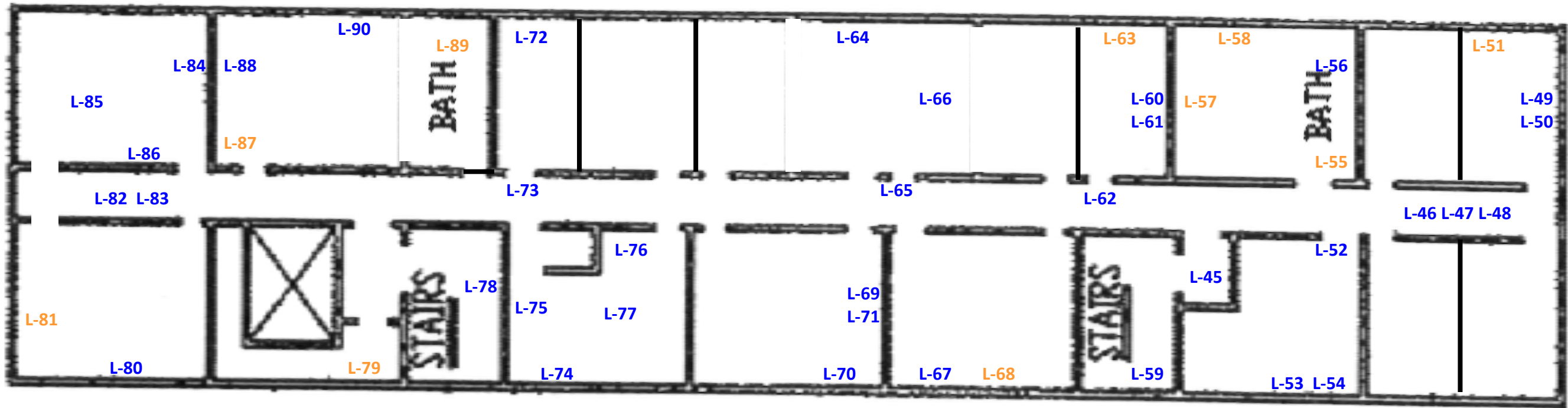
SME/ESHA JOB #

231600

SAMPLING DATE:

11-21-2023

LEAD-BASED PAINT DETERMINATION by XRF  
CETA BUILDING  
27 Independence Drive, Augusta, Maine



THIRD FLOOR



**KEY:**

**L-#** PAINT TESTING LOCATION with LEAD < 0.3 mg/cm<sup>2</sup> by XRF  
INDICATING NO PRESENCE of LEAD

**L-#** PAINT TESTING LOCATION with LEAD > 1.0 mg/cm<sup>2</sup> by XRF  
INDICATING PRESENCE of LEAD

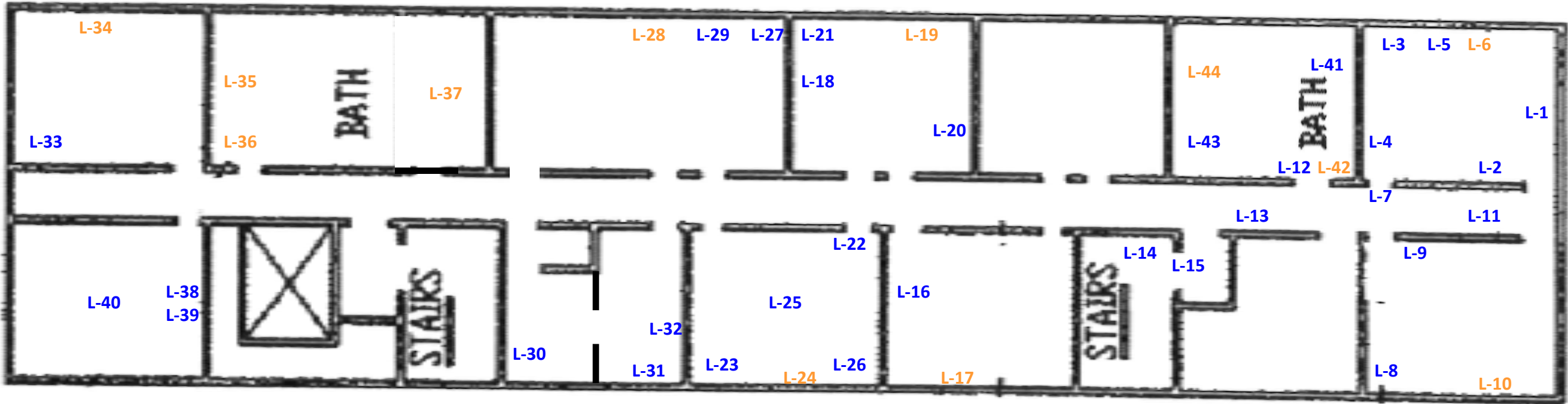
**SME**  
SEVEE & MAHER  
ENGINEERS

**ESHA**  
ENVIRONMENTAL SAFETY  
& HYGIENE ASSOCIATES  
A Sevee & Maher Engineers company

SME/ESHA JOB #  
  
231600

SAMPLING DATE:  
  
11-21-2023

LEAD-BASED PAINT DETERMINATION by XRF  
CETA BUILDING  
27 Independence Drive, Augusta, Maine



SECOND FLOOR



**KEY:**

**L-#** PAINT TESTING LOCATION with LEAD < 0.3 mg/cm<sup>2</sup> by XRF INDICATING NO PRESENCE of LEAD

**L-#** PAINT TESTING LOCATION with LEAD > 1.0 mg/cm<sup>2</sup> by XRF INDICATING PRESENCE of LEAD

**SME**  
SEVEE & MAHER  
ENGINEERS

**ESHA**  
ENVIRONMENTAL SAFETY  
& HYGIENE ASSOCIATES  
A Sevee & Maher Engineers company

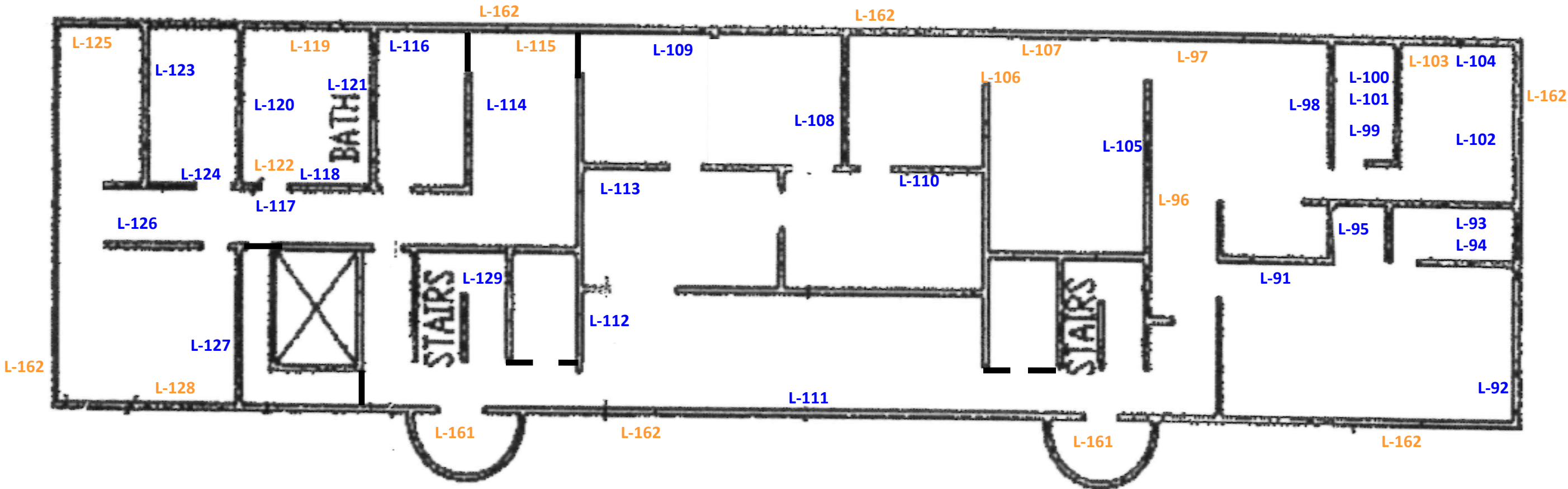
SME/ESHA JOB #  
231600

SAMPLING DATE:  
11-21-2023

# LEAD-BASED PAINT DETERMINATION by XRF

CETA BUILDING

27 Independence Drive, Augusta, Maine



FIRST FLOOR



**KEY:**

**L-#**

PAINT TESTING LOCATION with LEAD < 0.3 mg/cm<sup>2</sup> by XRF  
INDICATING NO PRESENCE of LEAD

**L-#**

PAINT TESTING LOCATION with LEAD > 1.0 mg/cm<sup>2</sup> by XRF  
INDICATING PRESENCE of LEAD

**SME**  
SEVEE & MAHER  
ENGINEERS

**ESHA**  
ENVIRONMENTAL SAFETY  
& HYGIENE ASSOCIATES  
A Sevee & Maher Engineers company

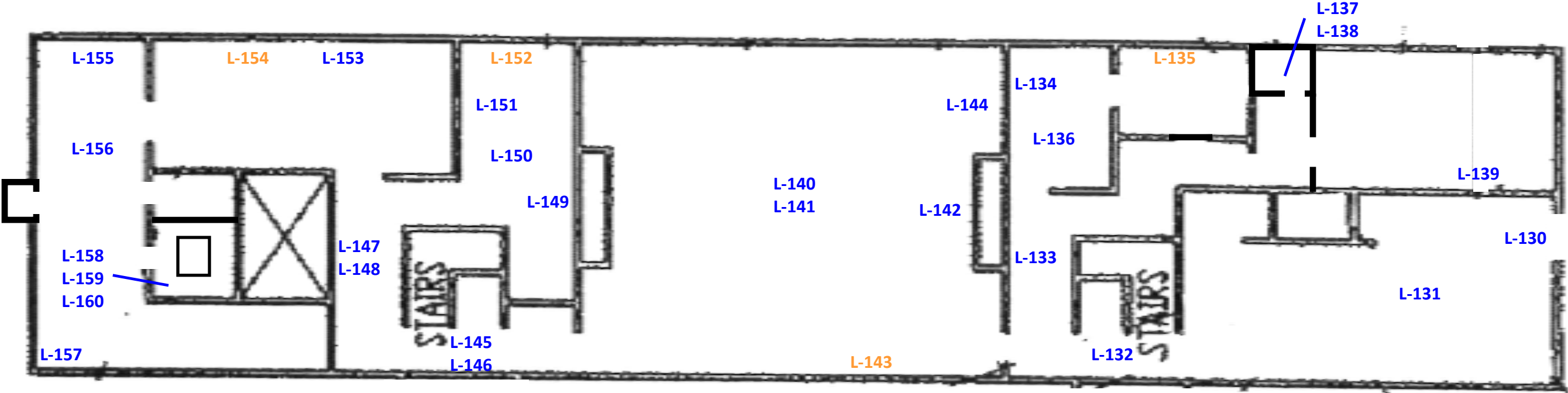
SME/ESHA JOB #

231600

SAMPLING DATE:

11-21-2023

LEAD-BASED PAINT DETERMINATION by XRF  
CETA BUILDING  
27 Independence Drive, Augusta, Maine



BASEMENT



KEY:	
L-#	PAINT TESTING LOCATION with LEAD < 0.3 mg/cm <sup>2</sup> by XRF INDICATING <u>NO PRESENCE of LEAD</u>
L-#	PAINT TESTING LOCATION with LEAD > 1.0 mg/cm <sup>2</sup> by XRF INDICATING <u>PRESENCE of LEAD</u>

 	SME/ESHA JOB #	231600
	SAMPLING DATE:	11-21-2023

## APPENDIX F

### PCB ANALYTICAL SUMMARY TABLES AND LABORATORY DATA

**ANALYSIS OF PCBs**  
**EPA SW-846 8082A/3540C**

**CLIENT:**

Oak Point Associates  
 231 Main Street  
 Biddeford, ME 04005

**TESTING LOCATION:**

CETA Building  
 27 Independence Drive  
 Augusta, ME 04330

**TESTING DATE:**

November 14, 2023

**PROJECT NUMBER:**

231600.00

**LAB ID:**

L2367840

SAMPLE ID:	LOCATION/DESCRIPTION	PARAMETER	RESULT PPM (mg/kg)
PCB-1	Third Floor Window Glazing – Off-White	Aroclor-1016	None Detected
		Aroclor-1221	None Detected
		Aroclor-1232	None Detected
		Aroclor-1242	None Detected
		Aroclor-1248	None Detected
		Aroclor-1254	None Detected
		Aroclor-1260	None Detected
		Aroclor-1262	None Detected
		Aroclor-1268	None Detected

SAMPLE ID:	LOCATION/DESCRIPTION	PARAMETER	RESULT PPM (mg/kg)
PCB-2	Second Floor Window Glazing – Off-White	Aroclor-1016	None Detected
		Aroclor-1221	None Detected
		Aroclor-1232	None Detected
		Aroclor-1242	None Detected
		Aroclor-1248	None Detected
		Aroclor-1254	None Detected
		Aroclor-1260	None Detected
		Aroclor-1262	None Detected
		Aroclor-1268	None Detected

\*Regulatory Limit for PCBs:  $\geq 50$  ppm



SAMPLE ID:	LOCATION/DESCRIPTION	PARAMETER	RESULT PPM (mg/kg)
PCB-3	First Floor Window Glazing – Off-White	Aroclor-1016	None Detected
		Aroclor-1221	None Detected
		Aroclor-1232	None Detected
		Aroclor-1242	None Detected
		Aroclor-1248	None Detected
		Aroclor-1254	None Detected
		Aroclor-1260	None Detected
		Aroclor-1262	None Detected
		Aroclor-1268	None Detected

SAMPLE ID:	LOCATION/DESCRIPTION	PARAMETER	RESULT PPM (mg/kg)
PCB-4	Exterior Caulking Window Trim Base Layer – Tan	Aroclor-1016	None Detected
		Aroclor-1221	None Detected
		Aroclor-1232	None Detected
		Aroclor-1242	None Detected
		Aroclor-1248	None Detected
		Aroclor-1254	None Detected
		Aroclor-1260	None Detected
		Aroclor-1262	None Detected
		Aroclor-1268	None Detected

SAMPLE ID:	LOCATION/DESCRIPTION	PARAMETER	RESULT PPM (mg/kg)
PCB-5	Exterior Caulking Window Trim Top Layer – Gray	Aroclor-1016	None Detected
		Aroclor-1221	None Detected
		Aroclor-1232	None Detected
		Aroclor-1242	None Detected
		Aroclor-1248	None Detected
		Aroclor-1254	None Detected
		Aroclor-1260	None Detected
		Aroclor-1262	None Detected
		Aroclor-1268	None Detected

\*Regulatory Limit for PCBs:  $\geq 50$  ppm

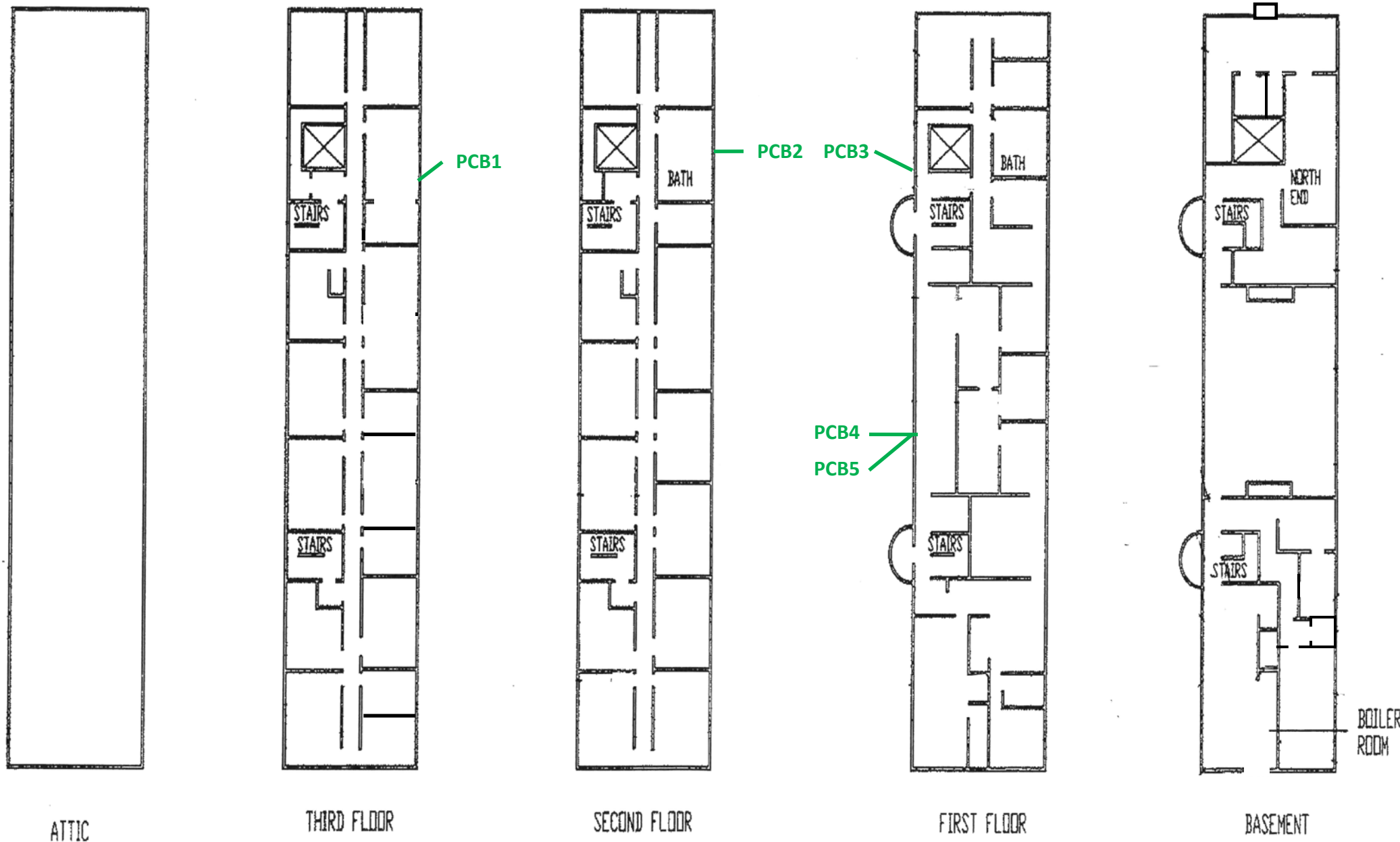
## APPENDIX G

### PCB TESTING DRAWINGS

# BUILDING MATERIAL ASSESSMENT for PCBS in CAULKING/GLAZING

## CETA BUILDING

27 Independence Drive, Augusta, Maine



**KEY:**

- PCB1** BULK SAMPLE <1 ppm for PCBs
- PCB1** BULK SAMPLE >1% - <50 ppm for PCBs
- PCB1** BULK SAMPLE ≥50 ppm for PCBs



SME/ESHA JOB # 231600

SAMPLING DATE: 11-14-2023

## APPENDIX H

### UNIVERSAL WASTE DRAWINGS

# UNIVERSAL WASTE DETERMINATION

## CETA BUILDING

27 Independence Drive, Augusta, Maine



**KEY:**

- MT** Mercury Thermostat
- SD** Smoke Detector
- FB** Fluorescent Bulb
- CFL** Compact Fluorescent Bulb
- UB** Fluorescent U-Bulb
- BAL** Ballast
- EL** Emergency Light – Battery + Lights
- FL** Flood Light (Metal Halide a/o High Pressure Sodium)
- HID** High Intensity Discharge Light

### ATTIC





SME/ESHA JOB #

231600

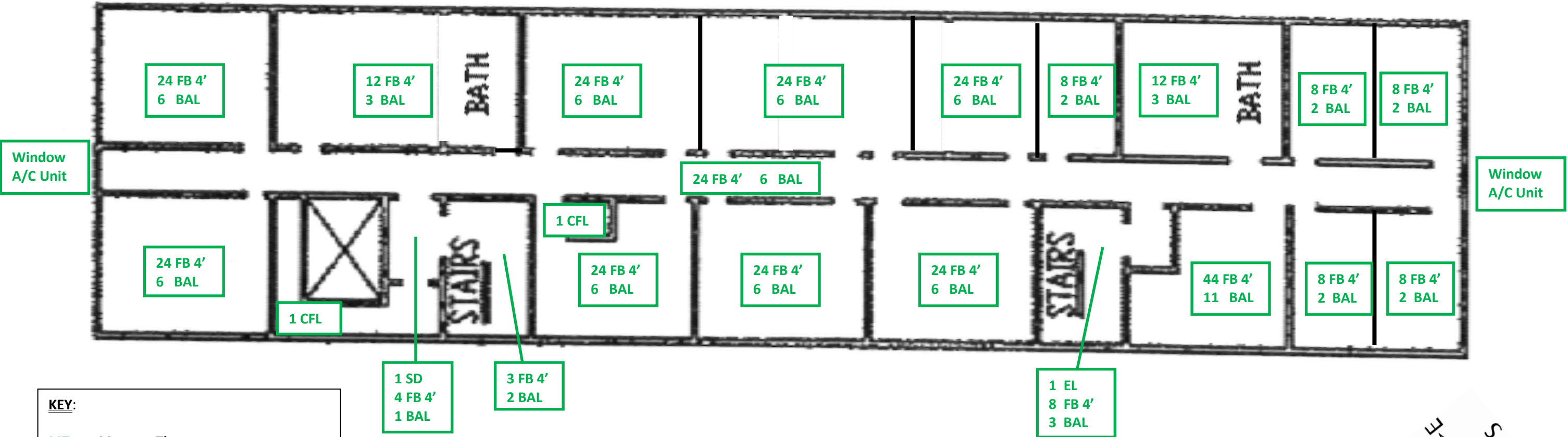
SAMPLING DATE:

11-14-2023

# UNIVERSAL WASTE DETERMINATION

## CETA BUILDING

27 Independence Drive, Augusta, Maine



**KEY:**

- MT** Mercury Thermostat
- SD** Smoke Detector
- FB** Fluorescent Bulb
- CFL** Compact Fluorescent Bulb
- UB** Fluorescent U-Bulb
- BAL** Ballast
- EL** Emergency Light – Battery + Lights
- HID** High Intensity Discharge Light

### THIRD FLOOR



**SME**  
SEVEE & MAHER  
ENGINEERS

**ESHA**  
ENVIRONMENTAL SAFETY  
& HYGIENE ASSOCIATES  
A Sevee & Maher Engineers company

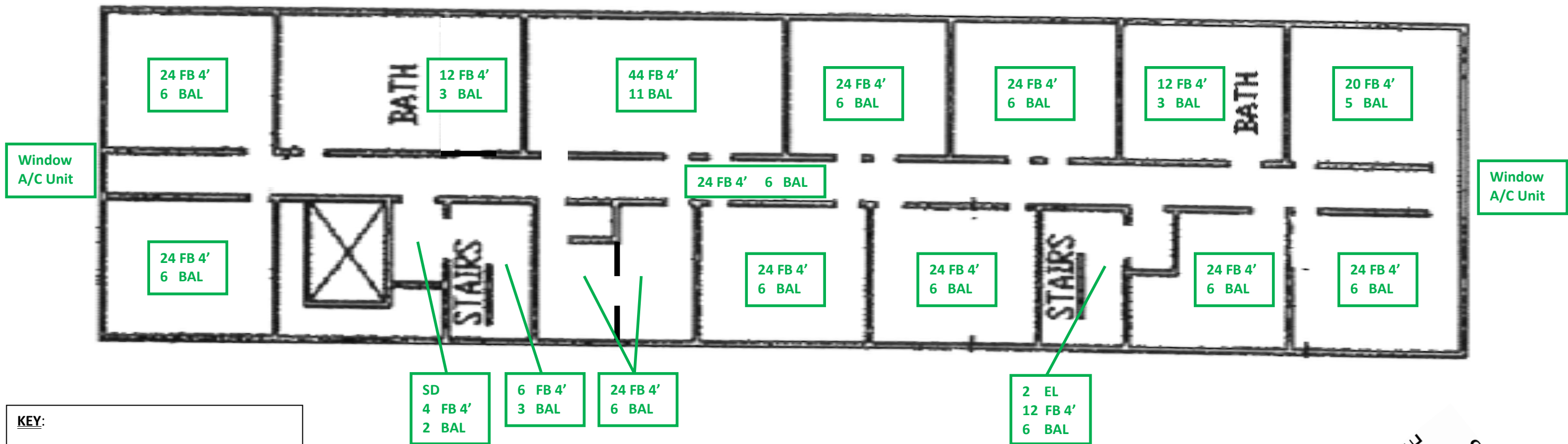
SME/ESHA JOB # 231600

SAMPLING DATE: 11-14-2023

# UNIVERSAL WASTE DETERMINATION

## CETA BUILDING

27 Independence Drive, Augusta, Maine



### SECOND FLOOR

KEY:	
MT	Mercury Thermostat
SD	Smoke Detector
FB	Fluorescent Bulb
CFL	Compact Fluorescent Bulb
UB	Fluorescent U-Bulb
BAL	Ballast
EL	Emergency Light – Battery + Lights
HID	High Intensity Discharge Light

**SME**  
SEVEE & MAHER  
ENGINEERS

**ESHA**  
ENVIRONMENTAL SAFETY  
& HYGIENE ASSOCIATES  
A Sevee & Maher Engineers company

SME/ESHA JOB #

231600

SAMPLING DATE:

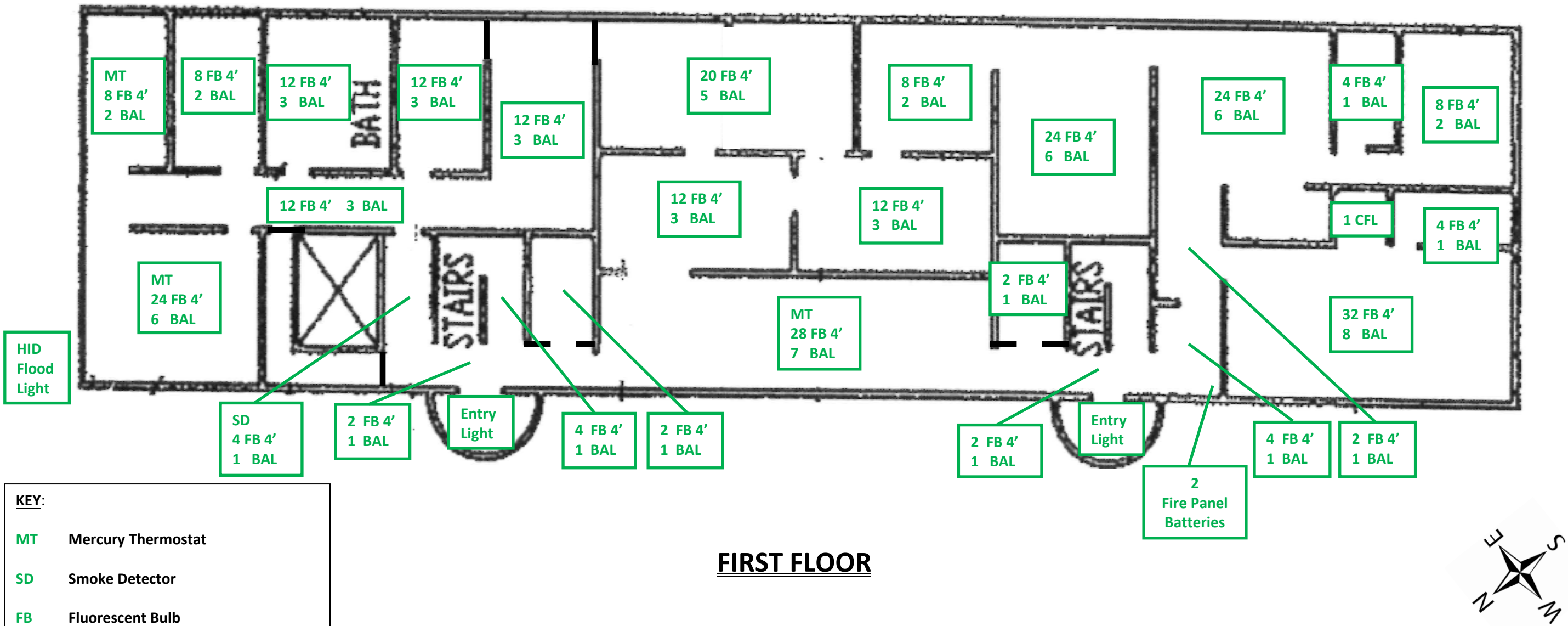
11-14-2023



# UNIVERSAL WASTE DETERMINATION

## CETA BUILDING

27 Independence Drive, Augusta, Maine



### FIRST FLOOR

**KEY:**

- MT** Mercury Thermostat
- SD** Smoke Detector
- FB** Fluorescent Bulb
- CFL** Compact Fluorescent Bulb
- UB** Fluorescent U-Bulb
- BAL** Ballast
- EL** Emergency Light – Battery + Lights
- HID** High Intensity Discharge



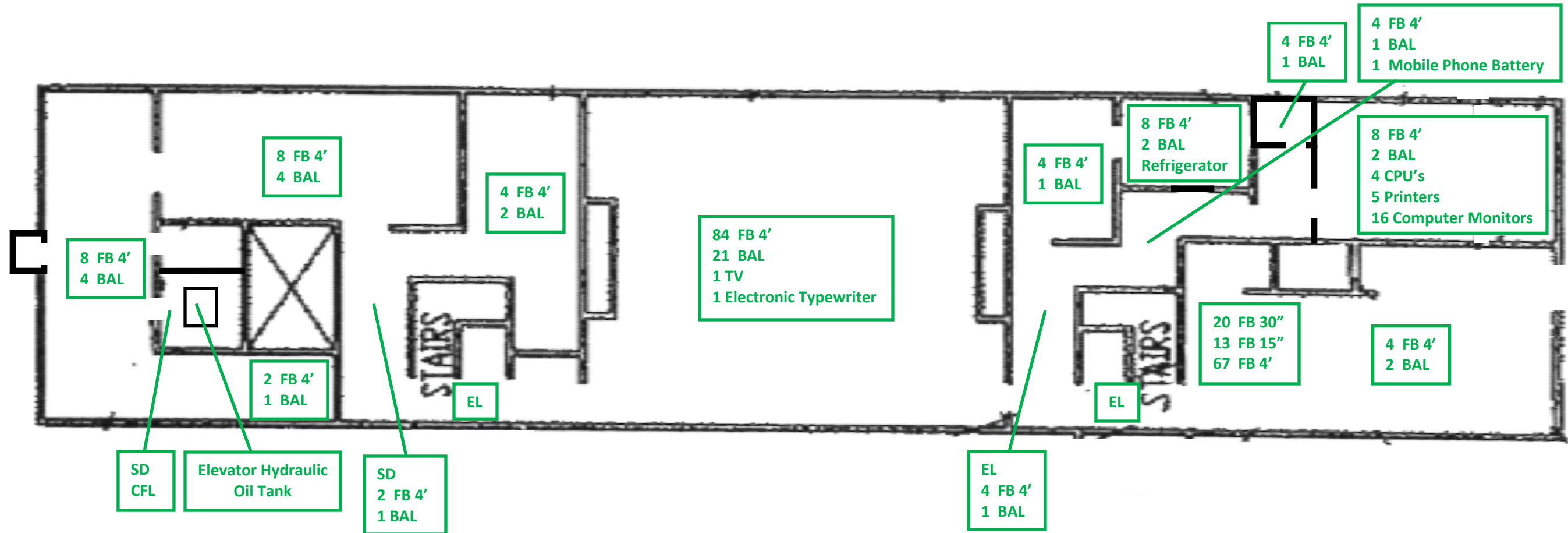
SME/ESHA JOB # 231600  
SAMPLING DATE: 11-14-2023



# UNIVERSAL WASTE DETERMINATION

## CETA BUILDING

## 27 Independence Drive, Augusta, Maine



## BASEMENT



**KEY:**

<b>MT</b>	<b>Mercury Thermostat</b>
<b>SD</b>	<b>Smoke Detector</b>
<b>FB</b>	<b>Fluorescent Bulb</b>
<b>CFL</b>	<b>Compact Fluorescent Bulb</b>
<b>UB</b>	<b>Fluorescent U-Bulb</b>
<b>BAL</b>	<b>Ballast</b>
<b>EL</b>	<b>Emergency Light – Battery</b>
<b>HID</b>	<b>High Intensity Discharge</b>



**SME/ESHA JOB #**

231600

**SAMPLING DATE:**

11-14-2023

**00 41 13**  
**Contractor Bid Form**

**NEW HEADQUARTERS BUILDING - INLAND FISHERIES AND WILDLIFE**  
BGS Project Number 3159

Bid Form submitted by: *paper documents only to address below*

Bid Administrator:

*Brian Keezer, Bureau Director*

BGS.Architect@Maine.gov

Bureau of General Services

111 Sewall Street, Cross State Office Building, 4th floor

77 State House Station

Augusta, Maine 04333-0077

Bidder:

Signature: \_\_\_\_\_

Printed name and  
title: \_\_\_\_\_

Company name: \_\_\_\_\_

Mailing address: \_\_\_\_\_

City, state, zip code: \_\_\_\_\_

Phone number: \_\_\_\_\_

Email address: \_\_\_\_\_

State of  
incorporation,  
if a corporation: \_\_\_\_\_

List of all partners,  
if a partnership: \_\_\_\_\_

The Bidder agrees, if the Owner offers to award the contract, to provide any and all bonds and certificates of insurance, as well as Schedule of Values, Project Schedule, and List of Subcontractors and Suppliers if required by the Owner, and to sign the designated Construction Contract within twelve calendar days after the date of notification of such acceptance, except if the twelfth day falls on a State of Maine government holiday or other closure day, or a Saturday, or a Sunday, in which case the aforementioned documents must be received before 12:00 noon on the first available business day following the holiday, other closure day, Saturday, or Sunday.

As a guarantee thereof, the Bidder submits, together with this bid, a bid bond or other acceptable instrument as and if required by the Bid Documents.

**00 41 13**  
**Contractor Bid Form**

1. The Bidder, having carefully examined the NEW HEADQUARTERS BUILDING - INLAND FISHERIES AND WILDLIFE Project Manual dated January 29, 2025, prepared by Oak Point Associates, as well as Specifications, Drawings, and any Addenda, the form of contract, and the premises and conditions relating to the work, proposes to furnish all labor, equipment and materials necessary for and reasonably incidental to the construction and completion of this project for the **Base Bid** amount of:

\$ \_\_\_\_\_

2. Unit Prices

Unit Price No. 1: Removal and Replacement of Unsatisfactory Soil: \_\_\_\_\_ cy

Unit Price No. 2: Mass Rock Excavation and Replacement: \_\_\_\_\_ cy

Unit Price No. 3: Trench Rock Excavation and Disposal: \_\_\_\_\_ cy

3. Alternate Bids:

Alternate No. 1: Replace remainder of Independence Drive to Arsenal Street as indicated on Sitework Drawings. \$\_\_\_\_\_ .00

Alternate No. 2: Provide Generator, installation and testing as indicated on electrical drawings. \$\_\_\_\_\_ .00

Alternate No. 3: Reduce interior glass partitions and replace with gypsum board partitions as indicated on drawings. \$\_\_\_\_\_ .00

Alternate No. 4: Reduce decorative ceilings and replace with suspended acoustical ceilings as indicated on drawings. \$\_\_\_\_\_ .00

4. Bid security *is required* on this project.

If noted above as required, or if the Base Bid amount exceeds \$125,000.00, the Bidder shall include with this bid form a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with this completed bid form submitted to the Owner.

5. Filed Sub-bids *are not required* on this project.

If noted above as required, the Bidder shall include with this bid form a list of each Filed Sub-bidder selected by the Bidder on the form provided (section 00 41 13F).

**00 43 13**  
**Contractor Bid Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of five percent of the bid amount, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns, signed this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the first specified bid due date, or subsequent bid due date revised by addendum.

The condition of the above obligation is such that whereas the principal has submitted to the Owner, or State of Maine, to a certain bid, attached hereto and hereby made a part hereof, to enter into a contract in writing, for the construction of insert name of project as designated in the contract documents

Now therefore:

If said bid shall be rejected, or, in the alternate,

If said bid shall be accepted and the principal shall execute and deliver a contract in the form of contract attached hereto, properly completed in accordance with said bid, and shall furnish a bond for the faithful performance of said contract, and for the payment of all persons performing labor or furnishing material in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid, then this obligation shall be void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time within which the Obligee may accept such bid and said Surety does hereby waive notice of any such extension.

**00 43 13**  
**Contractor Bid Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the first specified bid due date, or subsequent bid due date revised by addendum.

**Contractor**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*  
*insert city state zip code*

**Surety**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*  
*insert city state zip code*

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

**00 43 16**  
**Subcontractor Bid Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Subcontractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of five percent of the bid amount, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns, signed this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the first specified Subcontractor bid due date, or subsequent bid due date revised by addendum.

The condition of the above obligation is such that whereas the principal has submitted to the Owner, or State of Maine, to a certain Subcontractor bid, attached hereto and hereby made a part hereof, to enter into a subcontract in writing with any Contractor listed in said Subcontractor bid, provided the designated Contractor has entered into a written agreement with the Owner, for the construction of insert name of project as designated in the contract documents.

Now therefore:

If said Subcontractor bid shall be rejected, or, in the alternate,

If said Subcontractor bid shall be accepted and the principal shall execute and deliver a subcontract to the Contractor designated by the Owner in the form of subcontract attached hereto, properly completed in accordance with said Subcontractor bid, and shall furnish a bond for the faithful performance of said subcontract, and for the payment of all persons performing labor or furnishing material in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Subcontractor bid, then this obligation shall be void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time within which the Obligee may accept such Subcontractor bid and said Surety does hereby waive notice of any such extension.

**00 43 16**  
**Subcontractor Bid Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the first specified Subcontractor bid due date, or subsequent bid due date revised by addendum.

**Subcontractor**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

**Surety**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

If Subcontractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.



**State of Maine**  
**CONSTRUCTION CONTRACT**

**Large Construction Project**

*This form is used when the Contract value is \$50,000 or greater.  
The Project Manual, Specifications and Drawings, and any Addenda are considered part of this Contract.*

Agreement entered into by and between the **Bureau of General Services** hereinafter called the **Owner** and **Contractor company name** hereinafter called the **Contractor**.

BGS Project No.: **3159**

Other Project No.: \_\_\_\_\_

For the following Project: **NEW HEADQUARTERS BUILDING - INLAND FISHERIES AND WILDLIFE** at **East Campus, Augusta**, Maine.

The Specifications and the Drawings have been prepared by **Oak Point Associates**, acting as Professional-of-Record and named in the documents as the Consultant Architect or Engineer.

The *Owner* and *Contractor* agree as follows:

**ARTICLE 1 COMPENSATION AND PAYMENTS**

1.1 The Owner shall pay the Contractor to furnish all labor, equipment, materials and incidentals necessary for the construction of the Work described in the Specifications and shown on the Drawings the Contract Amount as shown below.

Base Bid	<b><u>\$0.00</u></b>
<i>Alternate Bid number and name or "no Alternates"</i>	<b><u>\$0.00</u></b>
<i>Alternate Bid number and name or "no Alternates"</i>	<b><u>\$0.00</u></b>
<i>Alternate Bid number and name or "no Alternates"</i>	<b><u>\$0.00</u></b>
<i>Alternate Bid number and name or "no Alternates"</i>	<b><u>\$0.00</u></b>
<i>Alternate Bid number and name or "no Alternates"</i>	<b><u>\$0.00</u></b>
<b>Total Contract Amount</b>	<b><u>\$0.00</u></b>

1.2 The Contractor's requisition shall contain sufficient detail and supporting information for the Owner to evaluate and support the payment requested.

1.2.1 Payments are due and payable twenty-five working days from the date of receipt of a Contractor requisition which is approved by the Owner.

1.2.2 Provisions for late payments are governed by 5 M.R.S. Chapter 144, *Payment of Invoices Received from Business Concerns*, and interest shall be calculated at 1% per month.

**ARTICLE 2 COMMENCEMENT AND COMPLETION DATES**

2.1 The Work of this Contract shall commence no sooner than the date this document is executed by the approval authority, or a subsequent date designated in the contract documents.

2.2 The Substantial Completion Date shall be **9 April 2027**.

2.3 The Work of this Contract shall be completed on or before the Contract Final Completion Date of 30 April 2027.

2.4 The Contract Expiration Date shall be 30 June 2027. (This date is the Owner's deadline for internal management of contract accounts. The Contract Expiration Date does not directly relate to any contract obligation of the Contractor.)

### ARTICLE 3 INELIGIBLE BIDDER

3.1 By signing this contract the Contractor attests that it has not been declared ineligible to bid on State of Maine projects. The Bureau of General Services may disallow award of this contract to any Contractor if there is evidence that the Contractor or any of its Subcontractors, through their own fault, have been terminated, suspended for cause, debarred from bidding, agreed to refrain from bidding as part of a settlement, have defaulted on a contract, or had a contract completed by another party.

3.2 By signing this contract the Contractor attests that it is not presently indicted for or otherwise criminally or civilly charged by a Federal, State or local government entity with commission of any of the following offenses and has not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction, or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

3.3 The Contractor shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs or State of Maine projects.

### ARTICLE 4 CONTRACTOR'S RESPONSIBILITIES

4.1 On this project, the Contractor shall furnish the Owner the appropriate contract bonds in the amount of 100% of the Contract Sum. Contract bonds are mandated if the Contract Sum exceeds \$125,000, or if bonds are specifically required by the Contract Documents.

4.2 The Contractor shall comply with all laws, codes and regulations applicable to the Work.

4.3 The Contractor shall acquire all permits and third-party approvals applicable to the Work not specifically identified as provided by the Owner. Costs for Contractor-provided permits and third-party approvals shall be included in the Contract Sum identified in Section 1.1 above.

4.4 The Contractor shall remain an independent agent for the duration of this Contract, shall not become an employee of the State of Maine, and shall assure that no State employee will be compensated by, or otherwise benefit from, this Contract.

4.5 The Contractor shall be responsible for any design cost, construction cost, or other cost incurred on the Project to the extent caused by the negligent acts, errors or omissions of the Contractor or their Subcontractors in the performance of Work under this Contract.

## ARTICLE 5 OWNER'S RESPONSIBILITIES

5.1 The Owner shall provide full information about the objectives, schedule, constraints and existing conditions of the project. The Owner has established a budget with reasonable contingencies that meets the project requirements.

5.2 By signing this contract, the Owner attests that all State of Maine procurement requirements for this contract have been met, including the solicitation of competitive bids.

## ARTICLE 6 INSTRUMENTS OF SERVICE

6.1 The Contractor's use of the drawings, specifications and other documents known as the Consultant's Instruments of Service is limited to the execution of the Contractor's scope of work of this project unless the Contractor receives the written consent of the Owner and Consultant for use elsewhere.

## ARTICLE 7 MISCELLANEOUS PROVISIONS

7.1 This Contract shall be governed by the laws of the State of Maine.

7.2 The Owner and Contractor, respectively, bind themselves, their partners, successors, assigns and legal representatives to this Contract. Neither party to this Contract shall assign the Contract as a whole without written consent of the other party, which consent the Owner may withhold without cause.

7.3 Notwithstanding any other provision of this Agreement, if the Owner does not receive sufficient funds to fund this Agreement or funds are de-appropriated, or if the Owner does not receive legal authority from the Maine State Legislature or Maine Courts to expend funds intended for this Agreement, then the Owner is not obligated to make payment under this Agreement; provided, however, the Owner shall be obligated to pay for services satisfactorily performed prior to any such non-appropriation in accordance with the termination provisions of this Agreement. The Owner shall timely notify the Contractor of any non-appropriation and the effective date of the non-appropriation.

## ARTICLE 8 CONTRACT DOCUMENTS

8.1 The Project Manual, Specifications and Drawings, and any Addenda, together with this agreement, form the contract. Each element is as fully a part of the Contract as if hereto attached or herein repeated.

8.2 Specifications: *indicate date of issuance of project manual*

8.3 Drawings: *note here or attach each sheet number and title*

8.4 Addenda: *note each addenda number and date, or "none"*

BGS Project No.: **3159**

The Contract is effective as of the date executed by the approval authority.

**OWNER****CONTRACTOR**


---

*Signature*                      *Date*  
*name and title*
*name of contracting entity*  
*address*
*telephone*  
*email address*


---

*Signature*                      *Date*  
*name and title*
*name of contractor company*  
*address*
*telephone*  
*email address*  
*Vendor Number*

Indicate the names of the review and approval individuals appropriate to the approval authority.

<i>select proper approval authority</i>			
Reviewed by:		Approved by:	
<i>Signature</i>	<i>Date</i>	<i>Signature</i>	<i>Date</i>
<i>Jill Instasi</i>		<i>Joseph H. Ostwald</i>	
<i>Project Manager/ Contract Administrator</i>		<i>Director, Planning, Design &amp; Construction</i>	

**00 61 13.13**  
**Contractor Performance Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly and faithfully perform the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

**00 61 13.13**  
**Contractor Performance Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

**Contractor**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

**Surety**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

**00 61 13.16**  
**Contractor Payment Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the use and benefit of claimants, defined as an entity having a contract with the principal or with a subcontractor of the principal for labor, materials, or both labor and materials, used or reasonably required for use in the performance of the contract, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly satisfy all claims and demands incurred for all labor and materials, used or required by the principal in connection with the work described in the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, and shall fully reimburse the obligee for all outlay and expense with said obligee may incur in making good any default of said principal, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.



**00 61 13.16**  
**Contractor Payment Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

**Contractor**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

**Surety**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

**00 61 13.23**  
**Subcontractor Performance Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Subcontractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto insert company name of Contractor in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly and faithfully perform the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee or Contractor may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

**00 61 13.23**  
**Subcontractor Performance Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

**Subcontractor**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

**Surety**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

If Subcontractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

**00 61 13.26**  
**Subcontractor Payment Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Subcontractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto insert company name of Contractor as obligee, in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the use and benefit of claimants, defined as an entity having a contract with the principal or with a subcontractor of the principal for labor, materials, or both labor and materials, used or reasonably required for use in the performance of the contract, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly satisfy all claims and demands incurred for all labor and materials, used or required by the principal in connection with the work described in the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, and shall fully reimburse the obligee for all outlay and expense with said obligee may incur in making good any default of said principal, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee or Contractor may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

**00 61 13.26**  
**Subcontractor Payment Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

**Subcontractor**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

**Surety**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

If Subcontractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

**00 71 00**  
**Definitions**

1. Definitions

- 1.1 *Addendum*: A document issued by the Consultant that amends the Bid Documents. Addenda shall not be issued less than seventy-two hours prior to the specified bid opening time.
- 1.2 *Allowance*: A specified dollar amount for a particular scope of work or service included in the Work that is identified in the Bid Documents and included in each Bidder's Bid. The Contractor shall document expenditures for an Allowance during the Project. Any unused balance shall be credited to the Owner. The Contractor is responsible for notifying the Owner of anticipated expenses greater than the specified amount and the Owner is responsible for those additional expenses.
- 1.3 *Alternate Bid*: The Contractor's written offer of a specified dollar amount, submitted on the Bid Form, for the performance of a particular scope of work described in the Bid Documents. The Owner determines the low bidder based on the sum of the base Bid and any combination of Alternate Bids that the Owner selects.
- 1.4 *Architect*: A Consultant acting as, or supporting, the Professional-of-Record who is responsible for the design of the Project. Equivalent to "Consultant" in State of Maine contract forms.
- 1.5 *Architectural Supplemental Instruction (ASI)*: A written instruction from the Architect for the purpose of clarification of the Contract Documents. An ASI does not alter the Contract Price or Contract Time. ASIs may be responses to RFIs and shall be issued by the Architect in a timely manner to avoid any negative impact on the Schedule of the Work.
- 1.6 *Bid*: The Contractor's written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of the Work. A Bid may include bonds or other requirements. A base Bid is separate and distinct from Alternate Bids, being the only cost component necessary for the award of the contract, and representing the minimum amount of Work that is essential for the functioning of the Project.
- 1.7 *Bid Bond*: The security designated in the Bid Documents, furnished by Bidders as a guaranty of good faith to enter into a contract with the Owner, should a contract be awarded to that Bidder.
- 1.8 *Bidder*: Any business entity, individual or corporation that submits a bid for the performance of the work described in the Bid Documents, acting directly or through a duly authorized representative. See also *Responsive and Responsible Bidder*.
- 1.9 *Bid Documents*: The drawings, procurement and contracting requirements, general requirements, and the written specifications -including all addenda, that a bidder is required to reference in the submission of a bid.
- 1.10 *Bureau*: The State of Maine Bureau of General Services, or BGS, in the Department of Administrative and Financial Services.
- 1.11 *Calendar days*: Consecutive days, as occurring on a calendar, taking into account each day of the week, month, year, and any religious, national or local holidays. Calendar days are used for changes in Contract Time.

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- 1.12 *Certificate of Substantial Completion*: A document developed by the Consultant that describes the final status of the Work and establishes the date that the Owner may use the facility for its intended purpose. The Certificate of Substantial Completion may also include a provisional list of items - a "punch list" - remaining to be completed by the Contractor. The Certificate of Substantial Completion identifies the date from which the project warranty period commences.
- 1.13 *Certificate of Occupancy*: A document developed by a local jurisdiction such as the Code Enforcement Officer that grants permission to the Owner to occupy a building.
- 1.14 *Change Order (CO)*: A document that modifies the contract and establishes the basis of a specific adjustment to the Contract Price or the Contract Time, or both. Change Orders may address correction of omissions, errors, and document discrepancies, or additional requirements. Change Orders should include all labor, materials and incidentals required to complete the work described. A Change Order is not valid until signed by the Contractor, Owner and Consultant and approved by the Bureau.
- 1.15 *Change Order Proposal (COP) (see also Proposal)*: Contract change proposed by the Contractor regarding the contract amount, requirements, or time. The Contractor implements the work of a COP after it is accepted by all parties. Accepted COPs are incorporated into the contract by Change Order.
- 1.16 *Clerk of the Works*: The authorized representative of the Consultant on the job site. Clerk of the Works is sometimes called the Architect's representative.
- 1.17 *Construction Change Directive (CCD)*: A written order prepared by the Consultant and signed by the Owner and Consultant, directing a change in the Work prior to final agreement with the Contractor on adjustment, if any, in the Contract Price or Contract Time, or both.
- 1.18 *Contract*: A written agreement between the Owner and the successful bidder which obligates the Contractor to perform the work specified in the Contract Documents and obligates the Owner to compensate the Contractor at the mutually accepted sum, rates or prices.
- 1.19 *Contract Bonds (also known as Payment and Performance Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.20 *Contract Documents*: The drawings and written specifications (including all addenda), Standard General Conditions, and the contract (including all Change Orders subsequently incorporated in the documents).
- 1.21 *Contract Expiration Date*: Date determined by the Owner as a deadline for internal management of contract accounts. This allows time after the Contract Final Completion Date for processing the final Requisition for Payment. The Contract Expiration Date does not directly relate to any contract obligation of the Contractor.
- 1.22 *Contract Final Completion Date*: Point of time when the Work is fully completed in compliance with the Contract Documents, as certified by the Consultant. Final payment to the Contractor is due upon Final Completion of the Project.
- 1.23 *Contract Price*: The dollar amount of the construction contract, also called *Contract Sum*.



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- 1.24 *Contract Time*: The designated duration of time to execute the Work of the contract, with a specific date for completion.
- 1.25 *Contractor*: Also called the "General Contractor" or "GC" the individual or entity undertaking the execution of the general contract work under the terms of the contract with the Owner, acting directly or through a duly authorized representative. The Contractor is responsible for the means, methods and materials utilized in the execution and completion of the Work.
- 1.26 *Consultant*: The Architect or Engineer acting as Professional-of-Record for the Project. The Consultant is responsible for the design of the Project.
- 1.27 *Drawings*: The graphic and pictorial portion of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.
- 1.28 *Engineer*: A Consultant acting as, or supporting, the Professional-of-Record who is responsible for the design of the Project. Equivalent to "Consultant" in State of Maine contract forms.
- 1.29 *Filed Sub-bid*: The designated major Subcontractor's (or, in some cases, Contractor's) written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of a particular portion of the Work. A Filed Sub-bid may include bonds or other requirements.
- 1.30 *General Requirements*: The on-site overhead expense items the Contractor provides for the Project, typically including, but not limited to, building permits, construction supervision, Contract Bonds, insurance, field office, temporary utilities, rubbish removal, and site fencing. Overhead expenses of the Contractor's general operation are not included. Sometimes referred to as the Contractor's General Conditions.
- 1.31 *Owner*: The State agency which is represented by duly authorized individuals. The Owner is responsible for defining the scope of the Project and compensation to the Consultant and Contractor.
- 1.32 *Owner's Representative*: The individual or entity contracted by the Owner to be an advisor and information conduit regarding the Project.
- 1.33 *Overhead*: General and administrative expenses of the Contractor's principal and branch offices, including payroll costs and other compensation of Contractor employees, deductibles paid on any insurance policy, charges against the Contractor for delinquent payments, and costs related to the correction of defective work, and the Contractor's capital expenses, including interest on capital used for the work.
- 1.34 *Performance and Payment Bonds (also known as Contract Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.35 *Post-Bid Addendum*: Document issued by the Consultant that defines a potential Change Order prior to signing of the construction contract. The Post-Bid Addendum allows the Owner to negotiate

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contract changes with the Bidder submitting the lowest valid bid, only if the negotiated changes to the Bid Documents result in no change or no increase in the bid price.

A Post-Bid Addendum may also be issued after a competitive construction Bid opening to those Bidders who submitted a Bid initially, for the purpose of rebidding the Project work without re-advertising.

- 1.36 *Project*: The construction project proposed by the Owner to be constructed according to the Contract Documents. The Project, a public improvement, may be tied logistically to other public improvements and other activities conducted by the Owner or other contractors.
- 1.37 *Proposal (see also Change Order Proposal)*: The Contractor's written offer submitted to the Owner for consideration containing a specified dollar amount or rate, for a specific scope of work, and including a schedule impact, if any. A proposal shall include all costs for overhead and profit. The Contractor implements the work of a Proposal after it is accepted by all parties. Accepted Proposals are incorporated into the contract by Change Order.
- 1.38 *Proposal Request (PR)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.39 *Punch List*: A document that identifies the items of work remaining to be done by the Contractor at the Close Out of a Project. The Punch List is created as a result of a final inspection of the work only after the Contractor attests that all of the Work is in its complete and permanent status.
- 1.40 *Request For Information (RFI)*: A Contractor's written request to the Consultant for clarification, definition or description of the Work. RFIs shall be presented by the Contractor in a timely manner to avoid any negative impact on the Schedule of the Work.
- 1.41 *Request For Proposal (RFP)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.42 *Requisition for Payment*: The document in which the Contractor certifies that the Work described is, to the best of the Contractor's knowledge, information and belief, complete and that all previous payments have been paid by the Contractor to Subcontractors and suppliers, and that the current requested payment is now due. See *Schedule of Values*.
- 1.43 *Responsive and Responsible Bidder*: A bidder who complies, when submitting a bid on a given project, with the following *responsive* standards, as required by the Bid Documents:
- submits specific qualifications to bid the project, if required;
  - attends mandatory pre-bid conferences, if required;
  - submits a bid prior to the close of the bid period;
  - submits a complete bid form;
  - submits a bid without indications of intent contrary to the stated requirements;
  - submits other materials and information, such as bid security, as required;
- and, meets the following minimums regarding these *responsible* standards:
- sustains a satisfactory record of project performance;
  - maintains a permanent place of business in a known physical location;
  - possesses the financial means for short- and long-term operations;
  - possesses the appropriate technical experience and capabilities;
  - employs adequate personnel and subcontractor resources;

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maintains the equipment needed to perform the work;  
complies with the proposed implementation schedule;  
complies with the insurance and bonding requirements;  
provides post-construction warranty coverage;  
and other criteria which can be considered relevant to the contract.

- 1.44 *Retainage*: The amount, calculated at five percent (5%) of the contract value or a scheduled value, that the Owner shall withhold from the Contractor until the work or portion of work is declared substantially complete or otherwise accepted by the Owner. The Owner may, if requested, reduce the amount withheld if the Owner deems it desirable and prudent to do so. (See Title 5 M.R.S.A., Section 1746.)
- 1.45 *Sample*: A physical example provided by the Contractor which illustrates materials, equipment or workmanship and establishes standards by which the Work will be judged.
- 1.46 *Schedule of the Work*: The document prepared by the Contractor and approved by the Owner that specifies the dates on which the Contractor plans to begin and complete various parts of the Work, including dates on which information and approvals are required from the Owner.
- 1.47 *Schedule of Values*: The document prepared by the Contractor and approved by the Owner before the commencement of the Work that specifies the dollar values of discrete portions of the Work equal in sum to the contract amount. The Schedule of Values is used to document progress payments of the Work in regular (usually monthly) requisitions for payment. See *Requisition for Payment*.
- 1.48 *Shop Drawings*: The drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.
- 1.49 *Specifications*: The portion of the Contract Documents consisting of the written requirements of the Work for materials, equipment, systems, standards, workmanship, and performance of related services.
- 1.50 *Subcontractor*: An individual or entity undertaking the execution of any part of the Work by virtue of a written agreement with the Contractor or any other Subcontractor. Also, an individual or entity retained by the Contractor or any other Subcontractor as an independent contractor to provide the labor, materials, equipment or services necessary to complete a specific portion of the Work.
- 1.51 *Substantial Completion Date*: Point of time when the Work or a designated portion of the Work is sufficiently complete in compliance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended purpose without unscheduled disruption. Substantial Completion is documented by the date of the Certificate of Substantial Completion signed by the Owner and the Contractor.
- 1.52 *Superintendent*: The representative of the Contractor on the job site, authorized by the Contractor to receive and fulfill instructions from the Consultant.
- 1.53 *Surety*: The individual or entity that is legally bound with the Contractor and Subcontractor to insure the faithful performance of the contract and for the payment of the bills for labor, materials and equipment by the Contractor and Subcontractors.

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- 1.54 *Work*: The construction and services, whether completed or partially completed, including all labor, materials, equipment and services provided or to be provided by the Contractor and Subcontractors to fulfill the requirements of the Project as described in the Contract Documents.

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**1. Preconstruction Conference**

- 1.1 The Contractor shall, upon acceptance of a contract and prior to commencing work, schedule a preconstruction conference with the Owner and Consultant. The purpose of this conference is as follows.
  - 1.1.1 Introduce all parties who have a significant role in the Project, including:
    - Owner (State agency or other contracting entity)
      - Owner's Representative
    - Consultant (Architect or Engineer)
      - Subconsultants
      - Clerk-of-the-works
    - Contractor (GC)
      - Superintendent
      - Subcontractors
    - Other State agencies
    - Construction testing company
    - Commissioning agent
    - Special Inspections agent
    - Bureau of General Services (BGS);
  - 1.1.2 Review the responsibilities of each party;
  - 1.1.3 Review any previously-identified special provisions of the Project;
  - 1.1.4 Review the Schedule of the Work calendar submitted by the Contractor to be approved by the Owner and Consultant;
  - 1.1.5 Review the Schedule of Values form submitted by the Contractor to be approved by the Owner and Consultant;
  - 1.1.6 Establish routines for Shop Drawing approval, contract changes, requisitions, et cetera;
  - 1.1.7 discuss jobsite issues;
  - 1.1.8 Discuss Project close-out procedures;
  - 1.1.9 Provide an opportunity for clarification of Contract Documents before work begins; and
  - 1.1.10 Schedule regular meetings at appropriate intervals for the review of the progress of the Work.

**2. Intent and Correlation of Contract Documents**

- 2.1 The intent of the Contract Documents is to describe the complete Project. The Contract Documents consist of various components; each component complements the others. What is shown as a requirement by any one component shall be inferred as a requirement on all corresponding components.
- 2.2 The Contractor shall furnish all labor, equipment and materials, tools, transportation, insurance, services, supplies, operations and methods necessary for, and reasonably incidental to, the construction and completion of the Project. Any work that deviates from the Contract Documents which appears to be required by the exigencies of construction or by inconsistencies in the Contract Documents, will be determined by the Consultant and authorized in writing by the Consultant, Owner and the Bureau prior to execution. The Contractor shall be responsible for requesting clarifying information where the intent of the Contract Documents is uncertain.
- 2.3 The Contractor shall not utilize any apparent error or omission in the Contract Documents to the disadvantage of the Owner. The Contractor shall promptly notify the Consultant in writing of such errors or omissions. The Consultant shall make any corrections or clarifications necessary in such a situation to document the true intent of the Contract Documents.

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**3. Additional Drawings and Specifications**

- 3.1 Upon the written request of the Contractor, the Owner shall provide, at no expense to the Contractor, up to five sets of printed Drawings and Specifications for the execution of the Work.
- 3.2 The Consultant shall promptly furnish to the Contractor revised Drawings and Specifications, for the area of the documents where those revisions apply, when corrections or clarifications are made by the Consultant. All such information shall be consistent with, and reasonably inferred from, the Contract Documents. The Contractor shall do no work without the proper Drawings and Specifications.

**4. Ownership of Contract Documents**

- 4.1 The designs represented on the Contract Documents are the property of the Consultant. The Drawings and Specifications shall not be used on other work without consent of the Consultant.

**5. Permits, Laws, and Regulations**

- 5.1 The Owner is responsible for obtaining any zoning approvals or other similar local project approvals necessary to complete the Work, unless otherwise specified in the Contract Documents.
- 5.2 The Owner is responsible for obtaining Maine Department of Environmental Protection, Maine Department of Transportation, or other similar state government project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.
- 5.3 The Owner is responsible for obtaining any federal agency project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.
- 5.4 The Owner is responsible for obtaining all easements for permanent structures or permanent changes in existing facilities.
- 5.5 The Contractor is responsible for obtaining and paying for all permits and licenses necessary for the implementation of the Work. The Contractor shall notify the Owner of any delays, variance or restrictions that may result from the issuing of permits and licenses.
- 5.6 The Contractor shall comply with all ordinances, laws, rules and regulations and make all required notices bearing on the implementation of the Work. In the event the Contractor observes disagreement between the Drawings and Specifications and any ordinances, laws, rules and regulations, the Contractor shall promptly notify the Consultant in writing. Any necessary changes shall be made as provided in the contract for changes in the work. The Contractor shall not perform any work knowing it to be contrary to such ordinances, laws, rules and regulations.
- 5.7 The Contractor shall comply with local, state and federal regulations regarding construction safety and all other aspects of the Work.
- 5.8 The Contractor shall comply with the Maine Code of Fair Practices and Affirmative Action, 5 M.R.S. §784 (2).



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**6. Taxes**

- 6.1 The Owner is exempt from the payment of Maine State sales and use taxes as provided in 36 M.R.S. §1760 (1). The Contractor and Subcontractors shall not include taxes on exempt items in the construction contract.
- 6.2 Section 1760 further provides in subsection 61 that sales to a construction contractor or its subcontractor of tangible personal property that is to be physically incorporated in, and become a permanent part of, real property for sale to or owned by the Owner, are exempt from Maine State sales and use taxes. Tangible personal property is defined in 36 M.R.S. §1752 (17).
- 6.3 The Contractor may contact Maine Revenue Services, 24 State House Station, Augusta, Maine 04333 for guidance on tax exempt regulations authorized by 36 M.R.S. §1760 and detailed in Rule 302 (18-125 CMR 302).

**7. Labor and Wages**

- 7.1 The Contractor shall conform to the labor laws of the State of Maine, and all other laws, ordinances, and legal requirements affecting the work in Maine.
- 7.2 The Consultant shall include a wage determination document prepared by the Maine Department of Labor in the Contract Documents for state-funded contracts in excess of \$50,000. The document shows the minimum wages required to be paid to each category of labor employed on the project.
- 7.3 On projects requiring a Maine wage determination, the Contractor shall submit monthly payroll records to the Owner ("the contracting agency") showing the name and occupation of all workers and all independent contractors employed on the project. The monthly submission must also include the Contractor's company name, the title of the project, hours worked, hourly rate or other method of remuneration, and the actual wages or other compensation paid to each person.
- 7.4 The Contractor shall not reveal, in the payroll records submitted to the Owner, personal information regarding workers and independent contractors, other than the information described above. Such information shall not include Social Security number, employee identification number, or employee address or phone number, for example.
- 7.5 The Contractor shall conform to Maine statute (39-A M.R.S. §105-A (6)) by providing to the Workers' Compensation Board a list of all subcontractors and independent contractors on the job site and a record of the entity to whom that subcontractor or independent contractor is directly contracted and by whom that subcontractor or independent contractor is insured for workers' compensation purposes.
- 7.6 The Contractor shall enforce strict discipline and good order among their employees at all times, and shall not employ any person unfit or unskilled to do the work assigned to them.
- 7.7 The Contractor shall promptly pay all employees when their compensation is due, shall promptly pay all others who have billed and are due for materials, supplies and services used in the Work, and shall promptly pay all others who have billed and are due for insurance, workers compensation coverage, federal and state unemployment compensation, and Social Security

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charges pertaining to this Project. Before final payments are made, the Contractor shall furnish to the Owner affidavits that all such payments described above have been made.

- 7.8 The Contractor may contact the Maine Department of Labor, 54 State House Station, Augusta, Maine 04333 for guidance on labor issues.
- 7.9 The Contractor may contact the Maine Workers' Compensation Board, 27 State House Station, Augusta, Maine 04333 for guidance on workers' compensation issues.

**8. Indemnification**

- 8.1 The Contractor shall indemnify and hold harmless the Owner and its officers and employees from and against any and all damages, liabilities, and costs, including reasonable attorney's fees, and defense costs, for any and all injuries to persons or property, including claims for violation of intellectual property rights, to the extent caused by the negligent acts or omissions of the Contractor, its employees, agents, officers or subcontractors in the performance of work under this Agreement. The Contractor shall not be liable for claims to the extent caused by the negligent acts or omissions of the Owner or for actions taken in reasonable reliance on written instructions of the Owner.
- 8.2 The Contractor shall notify the Owner promptly of all claims arising out of the performance of work under this Agreement by the Contractor, its employees or agents, officers or subcontractors.
- 8.3 This indemnity provision shall survive the termination of the Agreement, completion of the project or the expiration of the term of the Agreement.

**9. Insurance Requirements**

- 9.1 The Contractor shall provide, with each original of the signed Contract, an insurance certificate or certificates acceptable to the Owner and BGS. The Contractor shall submit insurance certificates to the Owner and BGS at the commencement of this Contract and at policy renewal or revision dates. The certificates shall identify the project name and BGS project number, and shall name the Owner as certificate holder and as additional insured for general liability and automobile liability coverages. The submitted forms shall contain a provision that coverage afforded under the insurance policies will not be canceled or materially changed unless at least ten days prior written notice by registered letter has been given to the Owner and BGS.
- 9.2 The Owner does not warrant or represent that the insurance required herein constitutes an insurance portfolio which adequately addresses all risks faced by the Contractor or its Subcontractors. The Contractor is responsible for the existence, extent and adequacy of insurance prior to commencement of work. The Contractor shall not allow any Subcontractor to commence work until all similar insurance required of the Subcontractor has been confirmed by the Contractor.
- 9.3 The Contractor shall procure and maintain primary insurance for the duration of the Project and, if written on a Claims-Made basis, shall also procure and maintain Extended Reporting Period (ERP) insurance for the period of time that any claims could be brought. The Contractor shall ensure that all Subcontractors they engage or employ will procure and maintain similar insurance

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in form and amount acceptable to the Owner and BGS. At a minimum, the insurance shall be of the types and limits set forth herein protecting the Contractor from claims which may result from the Contractor's execution of the Work, whether such execution be by the Contractor or by those employed by the Contractor or by those for whose acts they may be liable. All required insurance coverages shall be placed with carriers authorized to conduct business in the State of Maine by the Maine Bureau of Insurance.

- 9.3.1 The Contractor shall have Workers' Compensation insurance for all employees on the Project site in accordance with the requirements of the Workers' Compensation law of the State of Maine.

Minimum acceptable limits for Employer's Liability are:

Bodily Injury by Accident.....	\$500,000
Bodily Injury by Disease.....	\$500,000 Each Employee
Bodily Injury by Disease.....	\$500,000 Policy Limit

- 9.3.2 The Contractor shall have Commercial General Liability insurance providing coverage for bodily injury and property damage liability for all hazards of the Project including premise and operations, products and completed operations, contractual, and personal injury liabilities. The policy shall include collapse and underground coverage as well as explosion coverage if explosion hazards exist. Aggregate limits shall apply on a location or project basis. Minimum acceptable limits are:

General aggregate limit.....	\$2,000,000
Products and completed operations aggregate .....	\$1,000,000
Each occurrence limit.....	\$1,000,000
Personal injury aggregate .....	\$1,000,000

- 9.3.3 The Contractor shall have Automobile Liability insurance against claims for bodily injury, death or property damage resulting from the maintenance, ownership or use of all owned, non-owned and hired automobiles, trucks and trailers. Minimum acceptable limit is:

Any one accident or loss .....	\$500,000
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- 9.3.4 For the portion of a project which is new construction, the Contractor shall procure and maintain Builder's Risk insurance naming the Owner, Contractor, and any Subcontractor as insureds as their interest may appear. Covered causes of loss form shall be all Risks of Direct Physical Loss, endorsed to include flood, earthquake, transit and sprinkler leakage where sprinkler coverage is applicable. Unless specifically authorized in writing by the Owner, the limit of insurance shall not be less than the initial contract amount, for the portion of the project which is new construction, and coverage shall apply during the entire contract period and until the work is accepted by the Owner.

- 9.3.5 The Contractor shall have Owner's Protective Liability insurance for contract values \$50,000 and above, naming the Owner as the Named Insured. Minimum acceptable limits are:

General aggregate limit.....	\$2,000,000
Each occurrence limit.....	\$1,000,000

#### 10. Contract Bonds

- 10.1 When noted as required in the Bid Documents, the Contractor shall provide to the Owner a Performance Bond and a Payment Bond, or "contract bonds", upon execution of the contract. Each bond value shall be for the full amount of the contract and issued by a surety company authorized to do business in the State of Maine as approved by the Owner. The bonds shall be

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executed on the forms furnished in the Bid Documents. The bonds shall allow for any subsequent additions or deductions of the contract.

- 10.2 The contract bonds shall continue in effect for one year after final acceptance of the contract to protect the Owner's interest in connection with the one year guarantee of workmanship and materials and to assure settlement of claims for the payment of all bills for labor, materials and equipment by the Contractor.

**11. Patents and Royalties**

- 11.1 The Contractor shall, for all time, secure for the Owner the free and undisputed right to the use of any patented articles or methods used in the Work. The expense of defending any suits for infringement or alleged infringement of such patents shall be borne by the Contractor. Awards made regarding patent suits shall be paid by the Contractor. The Contractor shall hold the Owner harmless regarding patent suits that may arise due to installations made by the Contractor, and to any awards made as a result of such suits.
- 11.2 Any royalty payments related to the work done by the Contractor for the Project shall be borne by the Contractor. The Contractor shall hold the Owner harmless regarding any royalty payments that may arise due to installations made by the Contractor.

**12. Surveys, Layout of Work**

- 12.1 The Owner shall furnish all property surveys unless otherwise specified.
- 12.2 The Contractor is responsible for correctly staking out the Work on the site. The Contractor shall employ a competent surveyor to position all construction on the site. The surveyor shall run the axis lines, establish correct datum points and check each line and point on the site to insure their accuracy. All such lines and points shall be carefully preserved throughout the construction.
- 12.3 The Contractor shall lay out all work from dimensions given on the Drawings. The Contractor shall take measurements and verify dimensions of any existing work that affects the Work or to which the Work is to be fitted. The Contractor is solely responsible for the accuracy of all measurements. The Contractor shall verify all grades, lines, levels, elevations and dimensions shown on the Drawings and report any errors or inconsistencies to the Consultant prior to commencing work.

**13. Record of Documents**

- 13.1 The Contractor shall maintain one complete set of Contract Documents on the jobsite, in good order and current status, for access by the Owner and Consultant.
- 13.2 The Contractor shall maintain, continuously updated, complete records of Requests for Information, Architectural Supplemental Instructions (or equivalent), Information Bulletins, supplemental sketches, Change Order Proposals, Change Orders, Shop Drawings, testing reports, et cetera, for access by the Owner and Consultant.

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**14. Allowances**

- 14.1 The Contract Price shall include all allowances described in the Contract Documents. The Contractor shall include all overhead and profit necessary to implement each allowance in their Contract Price.
- 14.2 The Contractor shall not be required to employ parties for allowance work against whom the Contractor has a reasonable objection. In such a case, the Contractor shall notify the Owner in writing of their position and shall propose an alternative party to complete the work of the allowance.

**15. Shop Drawings**

- 15.1 The Contractor shall administer Shop Drawings prepared by the Contractor, Subcontractors, suppliers or others to conform to the approved Schedule of the Work. The Contractor shall verify all field measurements, check and authorize all Shop Drawings and schedules required by the Work. The Contractor is the responsible party and contact for the Contractor's work as well as that of Subcontractors, suppliers or others who provide Shop Drawings.
- 15.2 The Consultant shall review and acknowledge Shop Drawings, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents.
- 15.3 The Contractor shall provide monthly updated logs containing: requests for information, information bulletins, supplemental instructions, supplemental sketches, change order proposals, change orders, submittals, testing and deficiencies.
- 15.4 The Contractor shall make any corrections required by the Consultant, and shall submit a quantity of corrected copies as may be needed. The acceptance of Shop Drawings or schedules by the Consultant shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications, unless the Contractor has called such deviations to the attention of the Consultant at the time of submission and secured the Consultant's written approval. The acceptance of Shop Drawings or schedules by the Consultant does not relieve the Contractor from responsibility for errors in Shop Drawings or schedules.

**16. Samples**

- 16.1 The Contractor shall furnish for approval, with reasonable promptness, all samples as directed by the Consultant. The Consultant shall review and approve such samples, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents. The subsequent work shall be in accord with the approved samples.

**17. Substitutions**

- 17.1 The Contractor shall furnish items and materials described in the Contract Documents. If the item or material specified describes a proprietary product, or uses the name of a manufacturer, the term "or approved equal" shall be implied, if it is not included in the text. The specific item or material specified establishes a minimum standard for the general design, level of quality, type, function, durability, efficiency, reliability, compatibility, warranty coverage, installation factors

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and required maintenance. The Drawing or written Specification shall not be construed to exclude other manufacturers products of comparable design, quality, and efficiency.

- 17.2 The Contractor may submit detailed information about a proposed substitution to the Consultant for consideration. Particular models of items and particular materials which the Contractor asserts to be equal to the items and materials identified in the Contract Documents shall be allowed only with written approval by the Consultant. The request for substitution shall include a cost comparison and a reason or reasons for the substitution.
- 17.3 The Consultant may request additional information about the proposed substitution. The approval or rejection of a proposed substitution may be based on timeliness of the request, source of the information, the considerations of minimum standards described above, or other considerations. The Consultant should briefly state the rationale for the decision. The decision shall be considered final.
- 17.4 The duration of a substitution review process can not be the basis for a claim for delay in the Schedule of the Work.

**18. Assignment of Contract**

- 18.1 The Contractor shall not assign or sublet the contract as a whole without the written consent of the Owner. The Contractor shall not assign any money due to the Contractor without the written consent of the Owner.

**19. Separate Contracts**

- 19.1 The Owner reserves the right to create other contracts in connection with this Project using similar General Conditions. The Contractor shall allow the Owner's other contractors reasonable opportunity for the delivery and storage of materials and the execution of their work. The Contractor shall coordinate and properly connect the Work of all contractors.
- 19.2 The Contractor shall promptly report to the Consultant and Owner any apparent deficiencies in work of the Owner's other contractors that impacts the proper execution or results of the Contractor. The Contractor's failure to observe or report any deficiencies constitutes an acceptance of the Owner's other contractors work as suitable for the interface of the Contractor's work, except for latent deficiencies in the Owner's other contractors work.
- 19.3 Similarly, the Contractor shall promptly report to the Consultant and Owner any apparent deficiencies in their own work that would impact the proper execution or results of the Owner's other contractors.
- 19.4 The Contractor shall report to the Consultant and Owner any conflicts or claims for damages with the Owner's other contractors and settle such conflicts or claims for damages by mutual agreement or arbitration, if necessary, at no expense to the Owner.
- 19.5 In the event the Owner's other contractors sue the Owner regarding any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor, who shall defend such proceedings at the Contractor's expense. The Contractor shall pay or satisfy any judgment that may arise against the Owner, and pay all other costs incurred.

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**20. Subcontracts**

- 20.1 The Contractor shall not subcontract any part of this contract without the written permission of the Owner.
- 20.2 The Contractor shall submit a complete list of named Subcontractors and material suppliers to the Consultant and Owner for approval by the Owner prior to commencing work. The Subcontractors named shall be reputable companies of recognized standing with a record of satisfactory work.
- 20.3 The Contractor shall not employ any Subcontractor or use any material until they have been approved, or where there is reason to believe the resulting work will not comply with the Contract Documents.
- 20.4 The Contractor, not the Owner, is as fully responsible for the acts and omissions of Subcontractors and of persons employed by them, as the Contractor is for the acts and omissions of persons directly or indirectly employed by the Contractor.
- 20.5 Neither the Contract Documents nor any Contractor-Subcontractor contract shall indicate, infer or create any direct contractual relationship between any Subcontractor and the Owner.

**21. Contractor-Subcontractor Relationship**

- 21.1 The Contractor shall be bound to the Subcontractor by all the obligations in the Contract Documents that bind the Contractor to the Owner.
- 21.2 The Contractor shall pay the Subcontractor, in proportion to the dollar value of the work completed and requisitioned by the Subcontractor, the approved dollar amount allowed to the Contractor no more than seven days after receipt of payment from the Owner.
- 21.3 The Contractor shall pay the Subcontractor accordingly if the Contract Documents or the subcontract provide for earlier or larger payments than described in the provision above.
- 21.4 The Contractor shall pay the Subcontractor for completed and requisitioned subcontract work, less retainage, no more than seven days after receipt of payment from the Owner for the Contractor's approved Requisition for Payment, even if the Consultant fails to certify a portion of the Requisition for Payment for a cause not the fault of the Subcontractor.
- 21.5 The Contractor shall not make a claim for liquidated damages or penalty for delay in any amount in excess of amounts that are specified by the subcontract.
- 21.6 The Contractor shall not make a claim for services rendered or materials furnished by the Subcontractor unless written notice is given by the Contractor to the Subcontractor within ten calendar days of the day in which the claim originated.
- 21.7 The Contractor shall give the Subcontractor an opportunity to present and to submit evidence in any progress conference or disputes involving subcontract work.



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- 21.8 The Contractor shall pay the Subcontractor a just share of any fire insurance payment received by the Contractor.
- 21.9 The Subcontractor shall be bound to the Contractor by the terms of the Contract Documents and assumes toward the Contractor all the obligations and responsibilities that the Contractor, by those documents, assumes toward the Owner.
- 21.10 The Subcontractor shall submit applications for payment to the Contractor in such reasonable time as to enable the Contractor to apply for payment as specified.
- 21.11 The Subcontractor shall make any claims for extra cost, extensions of time or damages, to the Contractor in the manner provided in these General Conditions for like claims by the Contractor to the Owner, except that the time for the Subcontractor to make claims for extra cost is seven calendar days after the receipt of Consultant's instructions.

**22. Supervision of the Work**

- 22.1 During all stages of the Work the Contractor shall have a competent superintendent, with any necessary assistant superintendents, overseeing the project. The superintendent shall not be reassigned without the consent of the Owner unless a superintendent ceases to be employed by the Contractor due to unsatisfactory performance.
- 22.2 The superintendent represents the Contractor on the jobsite. Directives given by the Consultant or Owner to the superintendent shall be as binding as if given directly to the Contractor's main office. All important directives shall be confirmed in writing to the Contractor. The Consultant and Owner are not responsible for the acts or omissions of the superintendent or assistant superintendents.
- 22.3 The Contractor shall provide supervision of the Work equal to the industry's highest standard of care. The superintendent shall carefully study and compare all Contract Documents and promptly report any error, inconsistency or omission discovered to the Consultant. The Contractor may not necessarily be held liable for damages resulting directly from any error, inconsistency or omission in the Contract Documents or other instructions by the Consultant that was not revealed by the superintendent in a timely way.

**23. Observation of the Work**

- 23.1 The Contractor shall allow the Owner, the Consultant and the Bureau continuous access to the site for the purpose of observation of the progress of the work. All necessary safeguards and accommodations for such observations shall be provided by the Contractor.
- 23.2 The Contractor shall coordinate all required testing, approval or demonstration of the Work. The Contractor shall give sufficient notice to the appropriate parties of readiness for testing, inspection or examination.
- 23.3 The Contractor shall schedule inspections and obtain all required certificates of inspection for inspections by a party other than the Consultant.

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- 23.4 The Consultant shall make all scheduled observations promptly, prior to the work being concealed or buried by the Contractor. If approval of the Work is required of the Consultant, the Contractor shall notify the Consultant of the construction schedule in this regard. Work concealed or buried prior to the Consultant's approval may need to be uncovered at the Contractor's expense.
- 23.5 The Consultant may order reexamination of questioned work, and, if so ordered, the work must be uncovered by the Contractor. If the work is found to conform to the Contract Documents, the Owner shall pay the expense of the reexamination and remedial work. If the work is found to not conform to the Contract Documents, the Contractor shall pay the expense, unless the defect in the work was caused by the Owner's Contractor, whose responsibility the reexamination expense becomes.
- 23.6 The Bureau shall periodically observe the Work during the course of construction and make recommendations to the Contractor or Consultant as necessary. Such recommendations shall be considered and implemented through the usual means for changes to the Work.
24. Consultant's Status
- 24.1 The Consultant represents the Owner during the construction period, and observes the work in progress on behalf of the Owner. The Consultant has authority to act on behalf of the Owner only to the extent expressly provided by the Contract Documents or otherwise demonstrated to the Contractor. The Consultant has authority to stop the work whenever such an action is necessary, in the Consultant's reasonable opinion, to ensure the proper execution of the contract.
- 24.2 The Consultant is the interpreter of the conditions of the contract and the judge of its performance. The Consultant shall favor neither the Owner nor the Contractor, but shall use the Consultant's powers under the contract to enforce faithful performance by both parties.
- 24.3 In the event of the termination of the Consultant's employment on the project prior to completion of the work, the Owner shall appoint a capable and reputable replacement. The status of the new Consultant relative to this contract shall be that of the former Consultant.
25. Management of the Premises
- 25.1 The Contractor shall place equipment and materials, and conduct activities on the premises in a manner that does not unreasonably hinder site circulation, environmental stability, or any long term effect. Likewise, the Consultant's directions shall not cause the use of premises to be impeded for the Contractor or Owner.
- 25.2 The Contractor shall not use the premises for any purpose other than that which is directly related to the scope of work. The Owner shall not use the premises for any purpose incompatible with the proposed work simultaneous to the work of the Contractor.
- 25.3 The Contractor shall enforce the Consultant's instructions regarding information posted on the premises such as signage and advertisements, as well as activities conducted on the premises such as fires, and smoking.

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25.4 The Owner may occupy any part of the Project that is completed with the written consent of the Contractor, and without prejudice to any of the rights of the Owner or Contractor. Such use or occupancy shall not, in and of itself, be construed as a final acceptance of any work or materials.

**26. Safety and Security of the Premises**

26.1 The Contractor shall designate, and make known to the Consultant and the Owner, a safety officer whose duty is the prevention of accidents on the site.

26.2 The Contractor shall continuously maintain security on the premises and protect from unreasonable occasion of injury all people authorized to be on the job site. The Contractor shall also effectively protect the property and adjacent properties from damage or loss.

26.3 The Contractor shall take all necessary precautions to ensure the safety of workers and others on and adjacent to the site, abiding by applicable local, state and federal safety regulations. The Contractor shall erect and continuously maintain safeguards for the protection of workers and others, and shall post signs and other warnings regarding hazards associated with the construction process, such as protruding fasteners, moving equipment, trenches and holes, scaffolding, window, door or stair openings, and falling materials.

26.4 The Contractor shall restore the premises to conditions that existed prior to the start of the project at areas not intended to be altered according to the Contract Documents.

26.5 The Contractor shall protect existing utilities and exercise care working in the vicinity of utilities shown in the Drawings and Specifications or otherwise located by the Contractor.

26.6 The Contractor shall protect from damage existing trees and other significant plantings and landscape features of the site which will remain a permanent part of the site. If necessary or indicated in the Contract Documents, tree trunks shall be boxed and barriers erected to prevent damage to tree branches or roots.

26.7 The Contractor shall repair or replace damage to the Work caused by the Contractor's or Subcontractor's forces, including that which is reasonably protected, at the expense of the responsible party.

26.8 The Contractor shall not load, or allow to be loaded, any part of the Project with a force which imperils personal or structural safety. The Consultant may consult with the Contractor on such means and methods of construction, however, the ultimate responsibility lies with the Contractor.

26.9 The Contractor shall not jeopardize any work in place with subsequent construction activities such as blasting, drilling, excavating, cutting, patching or altering work. The Consultant must approve altering any structural components of the project. The Contractor shall supervise all construction activities carried out by others on site to ensure that the work is neatly done and in a manner that will not endanger the structure or the component parts.

26.10 The Contractor may act with their sole discretion in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Contractor may negotiate with the Owner for compensation for expenses due to such emergency work.

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- 26.11 The Contractor and Subcontractors shall have no responsibility for the identification, discovery, presence, handling, removal or disposal of, or exposure of persons to, hazardous materials in any form at the project site. The Contractor shall avoid disruption of any hazardous materials or toxic substances at the project site and promptly notify the Owner in writing on the occasion of such a discovery.
- 26.12 The Contractor shall keep the premises free of any unsafe accumulation of waste materials caused by the work. The Contractor shall regularly keep the spaces "broom clean". See the Close-out of the Work provisions of this section regarding cleaning at the completion of the project.

**27. Changes in the Work**

- 27.1 The Contractor shall not proceed with extra work without an approved Change Order or Construction Change Directive. A Change Order which has been properly signed by all parties shall become a part of the contract.
- 27.2 A Change Order is the usual document for directing changes in the Work. In certain circumstances, however, the Owner may utilize a Construction Change Directive to direct the Contractor to perform changes in the Work that are generally consistent with the scope of the project. The Owner shall use a Construction Change Directive only when the normal process for approving changes to the Work has failed to the detriment of the Project, or when agreement on the terms of a Change Order cannot be met, or when an urgent situation requires, in the Owner's judgment, prompt action by the Contractor.
- 27.3 The Consultant shall prepare the Construction Change Directive representing a complete scope of work, with proposed Contract Price and Contract Time revisions, if any, clearly stated.
- 27.4 The Contractor shall promptly carry out a Construction Change Directive which has been signed by the Owner and the Consultant. Work thus completed by the Contractor constitutes the basis for a Change Order. Changes in the Contract Price and Contract Time shall be as defined in the Construction Change Directive unless subsequently negotiated with some other terms.
- 27.5 The method of determining the dollar value of extra work shall be by:
- .1 an estimate of the Contractor accepted by Owner as a lump sum, or
  - .2 unit prices named in the contract or subsequently agreed upon, or
  - .3 cost plus a designated percentage, or
  - .4 cost plus a fixed fee.
- 27.6 The Contractor shall determine the dollar value of the extra work for both the lump sum and cost plus designated percentage methods so as not to exceed the following rates. The rates include all overhead and profit expenses.
- .1 Contractor - for any work performed by the Contractor's own forces, up to 20% of the cost;
  - .2 Subcontractor - for work performed by Subcontractor's own forces, up to 20% of the cost;
  - .3 Contractor - for work performed by Contractor's Subcontractor, up to 10% of the amount due the Subcontractor.
- 27.7 The Contractor shall keep and provide records as needed or directed for the cost plus designated percentage method. The Consultant shall review and certify the appropriate amount which

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includes the Contractor's overhead and profit. The Owner shall make payments based on the Consultant's certificate.

- 27.8 Cost reflected in Change Orders shall be limited to the following: cost of materials, cost of delivery, cost of labor (including Social Security, pension, Workers' Compensation insurance, and unemployment insurance), and cost of rental of power tools and equipment. Labor cost may include a pro-ratio share of a foreman's time only in the case of an extension of contract time granted due to the Change Order.
- 27.9 Overhead reflected in Change Orders shall be limited to the following: bond premium, supervision, wages of clerks, time keepers, and watchmen, small tools, incidental expenses, general office expenses, and all other overhead expenses directly related to the Change Order.
- 27.10 The Contractor shall provide credit to the Owner for labor, materials, equipment and other costs but not overhead and profit expenses for those Change Order items that result in a net value of credit to the contract.
- 27.11 The Owner may change the scope of work of the Project without invalidating the contract. The Owner shall notify the Contractor of a change of the scope of work for the Owner's Contractors, which may affect the work of this Contractor, without invalidating the contract. Change Orders for extension of the time caused by such changes shall be developed at the time of directing the change in scope of work.
- 27.12 The Consultant may order minor changes in the Work, not involving extra cost, which is consistent with the intent of the design or project.
- 27.13 The Contractor shall immediately give written notification to the Consultant of latent conditions discovered at the site which materially differ from those represented in the Drawings or Specifications, and which may eventually result in a change in the scope of work. The Contractor shall suspend work until receiving direction from the Consultant. The Consultant shall promptly investigate the conditions and respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Consultant shall determine if the discovered conditions warrant a Change Order.
- 27.14 The Contractor shall, within ten calendar days of receipt of the information, give written notification to the Consultant if the Contractor claims that instructions by the Consultant will constitute extra cost not accounted for by Change Order or otherwise under the contract. The Consultant shall promptly respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Consultant shall determine if the Contractor's claim warrants a Change Order.

**28. Correction of the Work**

- 28.1 The Contractor shall promptly remove from the premises all work the Consultant declares is non-conforming to the contract. The Contractor shall replace the work properly at no expense to the Owner. The Contractor is also responsible for the expenses of others whose work was damaged or destroyed by such remedial work.

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- 28.2 The Owner may elect to remove non-conforming work if it is not removed by the Contractor within a reasonable time, that time defined in a written notice from the Consultant. The Owner may elect to store removed non-conforming work not removed by the Contractor at the Contractor's expense. The Owner may, with ten days written notice, dispose of materials which the Contractor does not remove. The Owner may sell the materials and apply the net proceeds, after deducting all expenses, to the costs that should have been borne by the Contractor.
- 28.3 The Contractor shall remedy any defects due to faulty materials or workmanship and pay for any related damage to other work which appears within a period of one year from the date of substantial completion, and in accord with the terms of any guarantees provided in the contract. The Owner shall promptly give notice of observed defects to the Contractor and Consultant. The Consultant shall determine the status of all claimed defects. The Contractor shall perform all remedial work without unjustifiable delay in either the initial response or the corrective action.
- 28.4 The Consultant may authorize, after a reasonable notification to the Contractor, an equitable deduction from the contract amount in lieu of the Contractor correcting non-conforming or defective work.
29. Owner's Right to do Work
- 29.1 The Owner may, using other contractors, correct deficiencies attributable to the Contractor, or complete unfinished work. Such action shall take place only after giving the Contractor three days written notice, and provided the Consultant approves of the proposed course of action as an appropriate remedy. The Owner may then deduct the cost of the remedial work from the amount due the Contractor.
- 29.2 The Owner may act with their sole discretion when the Contractor is unable to take action in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Owner shall inform the Contractor of the emergency work performed, particularly where it may affect the work of the Contractor.
30. Termination of Contract and Stop Work Action
- 30.1 The Owner may, owing to a certificate of the Consultant indicating that sufficient cause exists to justify such action, without prejudice to any other right or remedy and after giving the Contractor and the Contractor's surety seven days written notice, terminate the employment of the Contractor. At that time the Owner may take possession of the premises and of all materials,

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tools and appliances on the premises and finish the work by whatever method the Owner may deem expedient. Cause for such action by the Owner includes:

- .1 the contractor is adjudged bankrupt, or makes a general assignment for the benefit of its creditors, or
- .2 a receiver is appointed due to the Contractor's insolvency, or
- .3 the Contractor persistently or repeatedly refuses or fails to provide enough properly skilled workers or proper materials, or
- .4 the Contractor fails to make prompt payment to Subcontractors or suppliers of materials or labor, or
- .5 the Contractor persistently disregards laws, ordinances or the instructions of the Consultant, or is otherwise found guilty of a substantial violation of a provision of the Contract Documents.

- 30.2 The Contractor is not entitled, as a consequence of the termination of the employment of the Contractor as described above, to receive any further payment until the Work is finished. If the unpaid balance of the contract amount exceeds the expense of finishing the Work, including compensation for additional architectural, managerial and administrative services, such balance shall be paid to the Contractor. If the expense of finishing the Work exceeds the unpaid balance, the Contractor shall pay the difference to the Owner. The Consultant shall certify the expense incurred by the Contractor's default. This obligation for payment shall continue to exist after termination of the contract.
- 30.3 The Contractor may, if the Work is stopped by order of any court or other public authority for a period of thirty consecutive days, and through no act or fault of the Contractor or of anyone employed by the Contractor, with seven days written notice to the Owner and the Consultant, terminate this contract. The Contractor may then recover from the Owner payment for all work executed, any proven loss and reasonable profit and damage.
- 30.4 The Contractor may, if the Consultant fails to issue a certificate for payment within seven days after the Contractor's formal request for payment, through no fault of the Contractor, or if the Owner fails to pay to the Contractor within 30 days after submission of any sum certified by the Consultant, with seven days written notice to the Owner and the Consultant, stop the Work or terminate this Contract.

**31. Delays and Extension of Time**

- 31.1 The completion date of the contract shall be extended if the work is delayed by changes ordered in the work which have approved time extensions, or by an act or neglect of the Owner, the Consultant, or the Owner's Contractor, or by strikes, lockouts, fire, flooding, unusual delay in transportation, unavoidable casualties, or by other causes beyond the Contractor's control. The Consultant shall determine the status of all claimed causes.
- 31.2 The contract shall not be extended for delay occurring more than seven calendar days before the Contractor's claim made in writing to the Consultant. In case of a continuing cause of delay, only one claim is necessary.
- 31.3 The contract shall not be extended due to failure of the Consultant to furnish drawings if no schedule or agreement is made between the Contractor and the Consultant indicating the dates

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which drawings shall be furnished and fourteen calendar days has passed after said date for such drawings.

- 31.4 This article does not exclude the recovery of damages for delay by either party under other provisions in the Contract Document.

**32. Payments to the Contractor**

- 32.1 As noted under *Preconstruction Conference* in this section, the Contractor shall submit a Schedule of Values form, before the first application for payment, for approval by the Owner and Consultant. The Consultant may direct the Contractor to provide evidence that supports the correctness of the form. The approved Schedule of Values shall be used as a basis for payments.
- 32.2 The Contractor shall submit an application for each payment ("Requisition for Payment") on a form approved by the Owner and Consultant. The Consultant may require receipts or other documents showing the Contractor's payments for materials and labor, including payments to Subcontractors.
- 32.3 The Contractor shall submit Requisitions for Payment as the work progresses not more frequently than once each month, unless the Owner approves a more frequent interval due to unusual circumstances. The Requisition for Payment is based on the proportionate quantities of the various classes of work completed or incorporated in the Work, in agreement with the actual progress of the Work and the dollar value indicated in the Schedule of Values.
- 32.4 The Consultant shall verify and certify each Requisition for Payment which appears to be complete and correct prior to payment being made by the Owner. The Consultant may certify an appropriate amount for materials not incorporated in the Work which have been delivered and suitably stored at the site. The Contractor shall submit bills of sale, insurance certificates, or other such documents that will adequately protect the Owner's interests prior to payments being certified.
- 32.5 In the event any materials delivered but not yet incorporated in the Work have been included in a certified Requisition for Payment with payment made, and said materials thereafter are damaged, deteriorated or destroyed, or for any reason whatsoever become unsuitable or unavailable for use in the Work, the full amount previously allowed shall be deducted from subsequent payments unless the Contractor satisfactorily replaces said material.
- 32.6 The Contractor may request certification of an appropriate dollar amount for materials not incorporated in the Work which have been delivered and suitably stored away from the site. The Contractor shall submit bills of sale, insurance certificates, right-of-entry documents or other such documents that will adequately protect the Owner's interests. The Consultant shall determine if the Contractor's documentation for the materials is complete and specifically designated for the Project. The Owner may allow certification of such payments.
- 32.7 Subcontractors may request, and shall receive from the Consultant, copies of approved Requisitions for Payment showing the amounts certified in the Schedule of Values.
- 32.8 Certified Requisitions for Payment, payments made to the Contractor, or partial or entire occupancy of the project by the Owner shall not constitute an acceptance of any work that does



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not conform to the Contract Documents. The making and acceptance of the final payment constitutes a waiver of all claims by the Owner, other than those arising from unsettled liens, from faulty work or materials appearing within one year from final payment or from requirements of the Drawings and Specifications, and of all claims by the Contractor, except those previously made and still unsettled.

**33. Payments Withheld**

- 33.1 The Owner shall retain five percent of each payment due the Contractor as part security for the fulfillment of the contract by the Contractor. The Owner may make payment of a portion of this “retainage” to the Contractor temporarily or permanently during the progress of the Work. The Owner may thereafter withhold further payments until the full amount of the five percent is reestablished. The Contractor may deposit with the Maine State Treasurer certain securities in place of retainage amounts due according to Maine Statute (5 M.R.S. §1746).
- 33.2 The Consultant may withhold or nullify the whole or a portion of any Requisitions for Payment submitted by the Contractor in the amount that may be necessary, in his reasonable opinion, to protect the Owner from loss due to any of the following:
- .1 defective work not remedied;
  - .2 claims filed or reasonable evidence indicating probable filing of claims;
  - .3 failure to make payments properly to Subcontractors or suppliers;
  - .4 a reasonable doubt that the contract can be completed for the balance then unpaid;
  - .5 liability for damage to another contractor.

The Owner shall make payment to the Contractor, in the amount withheld, when the above circumstances are removed.

**34. Liens**

- 34.1 The Contractor shall deliver to the Owner a complete release of all liens arising out of this contract before the final payment or any part of the retainage payment is released. The Contractor shall provide with the release of liens an affidavit asserting each release includes all labor and materials for which a lien could be filed. Alternately, the Contractor, in the event any Subcontractor or supplier refuses to furnish a release of lien in full, may furnish a bond satisfactory to the Owner, to indemnify the Owner against any lien.
- 34.2 In the event any lien remains unsatisfied after all payments to the Contractor are made by the Owner, the Contractor shall refund to the Owner all money that the latter may be compelled to pay in discharging such lien, including all cost and reasonable attorney’s fees.

**35. Workmanship**

- 35.1 The Contractor shall provide materials, equipment, and installed work equal to or better than the quality specified in the Contract Documents and approved in submittal and sample. The installation methods shall be of the highest standards, and the best obtainable from the respective trades. The Consultant’s decision on the quality of work shall be final.

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- 35.2 The Contractor shall know local labor conditions for skilled and unskilled labor in order to apply the labor appropriately to the Work. All labor shall be performed by individuals well skilled in their respective trades.
- 35.3 The Contractor shall perform all cutting, fitting, patching and placing of work in such a manner to allow subsequent work to fit properly, whether that be by the Contractor, the Owner's Contractors or others. The Owner and Consultant may advise the Contractor regarding such subsequent work. Notwithstanding the notification or knowledge of such subsequent work, the Contractor may be directed to comply with this standard of compatible construction by the Consultant at the Contractor's expense.
- 35.4 The Contractor shall request clarification or revision of any design work by the Consultant, prior to commencing that work, in a circumstance where the Contractor believes the work cannot feasibly be completed at the highest quality, or as indicated in the Contract Documents. The Consultant shall respond to such requests in a timely way, providing clarifying information, a feasible revision, or instruction allowing a reduced quality of work. The Contractor shall follow the direction of the Consultant regarding the required request for information.
- 35.5 The Contractor shall guarantee the Work against any defects in workmanship and materials for a period of one year commencing with the date of the Certificate of Substantial Completion, unless specified otherwise for specific elements of the project. The Work may also be subdivided in mutually agreed upon components, each defined by a separate Certificate of Substantial Completion.
36. Close-out of the Work
- 36.1 The Contractor shall remove from the premises all waste materials caused by the work. The Contractor shall make the spaces "broom clean" unless a more thorough cleaning is specified. The Contractor shall clean all windows and glass immediately prior to the final inspection, unless otherwise directed.
- 36.2 The Owner may conduct the cleaning of the premises where the Contractor, duly notified by the Consultant, fails to adequately complete the task. The expense of this cleaning may be deducted from the sum due to the Contractor.
- 36.3 The Contractor shall participate in all final inspections and acknowledge the documentation of unsatisfactory work, customarily called the "punch list", to be corrected by the Contractor. The Consultant shall document the successful completion of the Work in a dated Certificate of Substantial Completion, to be signed by Owner, Consultant, and Contractor.
- 36.4 The Contractor shall not call for final inspection of any portion of the Work that is not completely and permanently installed. The Contractor may be found liable for the expenses of individuals called to final inspection meetings prematurely.
- 36.5 The Contractor and all major Subcontractors shall participate in the end-of-warranty-period conference, typically scheduled close to one year after the Substantial Completion date.

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**37. Date of Completion and Liquidated Damages**

- 37.1 The Contractor may make a written request to the Owner for an extension or reduction of time, if necessary. The request shall include the reasons the Contractor believes justifies the proposed completion date. The Owner may grant the revision of the contract completion date if the Work was delayed due to conditions beyond the control and the responsibility of the Contractor. The Contractor shall not conduct unauthorized accelerated work or file delay claims to recover alleged damages for unauthorized early completion.
- 37.2 The Contractor shall vigorously pursue the completion of the Work and notify the Owner of any factors that have, may, or will affect the approved Schedule of the Work. The Contractor may be found responsible for expenses of the Owner or Consultant if the Contractor fails to make notification of project delays.
- 37.3 The Project is planned to be done in an orderly fashion which allows for an iterative submittal review process, construction administration including minor changes in the Work and some bad weather. The Contractor shall not file delay claims to recover alleged damages on work the Consultant determines has followed the expected rate of progress.
- 37.4 The Consultant shall prepare the Certificate of Substantial Completion which, when signed by the Owner and the Contractor, documents the date of Substantial Completion of the Work or a designated portion of the Work. The Owner shall not consider the issuance of a Certificate of Occupancy by an outside authority a prerequisite for Substantial Completion if the Certificate of Occupancy cannot be obtained due to factors beyond the Contractor's control.
- 37.5 Liquidated Damages may be deducted from the sum due to the Contractor for each calendar day that the Work remains uncompleted after the completion date specified in the Contract or an approved amended completion date. The dollar amount per day shall be calculated using the Schedule of Liquidated Damages table shown below.

If the original contract amount is:	The per day Liquidated Damages shall be:
Less than \$100,000	\$250
\$100,000 to less than \$2,000,000	\$750
\$2,000,000 to less than \$10,000,000	\$1,500
\$10,000,000 and greater	\$1,500 plus \$250 for each \$2,000,000 over \$10,000,000

**38. Dispute Resolution**

**38.1 Mediation**

- 38.1.1 A dispute between the parties which arises under this Contract which cannot be resolved through informal negotiation, shall be submitted to a neutral mediator jointly selected by the parties.
- 38.1.2 Either party may file suit before or during mediation if the party, in good faith, deems it to be necessary to avoid losing the right to sue due to a statute of limitations. If suit is filed before good faith mediation efforts are completed, the party filing suit shall agree to stay all proceedings in the lawsuit pending completion of the mediation process, provided such stay is without prejudice.

**00 72 13**  
**General Conditions**

38.1.3 In any mediation between the Owner and the Consultant, the Owner has the right to consolidate related claims between Owner and Contractor.

38.2 Arbitration

38.2.1 If the dispute is not resolved through mediation, the dispute shall be settled by arbitration. The arbitration shall be conducted before a panel of three arbitrators. Each party shall select one arbitrator; the third arbitrator shall be appointed by the arbitrators selected by the parties. The arbitration shall be conducted in accordance with the Maine Uniform Arbitration Act (MUAA), except as otherwise provided in this section.

38.2.2 The decision of the arbitrators shall be final and binding upon all parties. The decision may be entered in court as provided in the MUAA.

38.2.3 The costs of the arbitration, including the arbitrators' fees shall be borne equally by the parties to the arbitration, unless the arbitrator orders otherwise.

38.2.4 In any arbitration between the Owner and the Consultant, the Owner has the right to consolidate related claims between Owner and Contractor.

**00 73 46**  
**Wage Determination Schedule**

**PART 1- GENERAL**

**1.1 Related Documents**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specifications Sections, apply to this Section.

**1.2 Summary**

- A. This Section includes the wage determination requirements for Contractors as issued by the State of Maine Department of Labor Bureau of Labor Standards or the United States Department of Labor.

**1.3 Requirements**

- A. Conform to the wage determination schedule for this project which is shown on the following page.

**PART 2 - PRODUCTS (not used)**

**PART 3 - EXECUTION (not used)**

End of Section 00 73 46

State of Maine Department of Labor - Bureau of Labor Standards  
Augusta, Maine 04333-0045 - Telephone (207) 623-7906

Wage Determination - In accordance with 26 MRS §1301 et. seq., this is a determination by the Bureau of Labor Standards, of the fair minimum wage rate to be paid to laborers and workers employed on the below titled project.

2024 Fair Minimum Wage Rates -- Building 2 Kennebec County (other than 1 or 2 family homes)

Occupational Title	Minimum Wage	Minimum Benefit	Total
Brickmasons And Blockmasons	\$42.55	\$28.02	\$70.57
Bulldozer Operator	\$31.50	\$7.53	\$39.03
Carpenter	\$29.68	\$12.51	\$42.19
Cement Masons And Concrete Finisher	\$24.13	\$4.15	\$28.28
Commercial Divers	\$30.00	\$4.62	\$34.62
Construction And Maintenance Painters	\$24.00	\$0.00	\$24.00
Construction Laborer	\$22.67	\$2.80	\$25.47
Crane And Tower Operators	\$38.50	\$10.43	\$48.93
Crushing Grinding And Polishing Machine Operators	\$23.00	\$4.94	\$27.94
Drywall And Ceiling Tile Installers	\$26.20	\$10.62	\$36.82
Earth Drillers - Except Oil And Gas	\$21.61	\$5.53	\$27.14
Electrical Power - Line Installer And Repairers	\$38.93	\$8.91	\$47.84
Electricians	\$38.51	\$6.00	\$44.51
Elevator Installers And Repairers	\$68.38	\$45.29	\$113.67
Excavating And Loading Machine And Dragline Operators	\$54.28	\$34.31	\$88.59
Excavator Operator	\$28.00	\$1.67	\$29.67
Fence Erectors	\$26.75	\$4.05	\$30.80
Flaggers	\$20.00	\$0.38	\$20.38
Floor Layers - Except Carpet/Wood/Hard Tiles	\$27.25	\$6.59	\$33.84
Glaziers	\$37.00	\$6.60	\$43.60
Grader/Scraper Operator	\$23.00	\$1.99	\$24.99
Hazardous Materials Removal Workers	\$21.00	\$1.99	\$22.99
Heating And Air Conditioning And Refrigeration Mechanics And Installers	\$32.00	\$5.60	\$37.60
Heavy And Tractor - Trailer Truck Drivers	\$22.75	\$1.04	\$23.79
Highway Maintenance Workers	\$20.00	\$0.00	\$20.00
Industrial Machinery Mechanics	\$31.25	\$1.01	\$32.26
Industrial Truck And Tractor Operators	\$29.25	\$4.06	\$33.31
Insulation Worker - Mechanical	\$23.00	\$3.59	\$26.59
Ironworker - Ornamental	\$30.83	\$24.97	\$55.80
Light Truck Or Delivery Services Drivers	\$23.34	\$1.67	\$25.01
Millwrights	\$33.75	\$8.78	\$42.53
Mobile Heavy Equipment Mechanics - Except Engines	\$27.75	\$4.89	\$32.64
Operating Engineers And Other Equipment Operators	\$24.00	\$2.38	\$26.38
Paver Operator	\$27.03	\$6.49	\$33.52
Pile-Driver Operators	\$32.75	\$1.95	\$34.70
Pipelayers	\$28.50	\$4.89	\$33.39
Plumbers Pipe Fitters And Steamfitters	\$29.50	\$5.48	\$34.98
Pump Operators - Except Wellhead Pumps	\$31.49	\$32.08	\$63.57
Radio Cellular And Tower Equipment Installers	\$26.00	\$3.77	\$29.77
Reclaimer Operator	\$27.03	\$7.68	\$34.71
Reinforcing Iron And Rebar Workers	\$30.83	\$24.97	\$55.80
Riggers	\$29.25	\$7.79	\$37.04
Roofers	\$23.75	\$3.11	\$26.86
Screed/Wheelman	\$29.25	\$4.94	\$34.19
Sheet Metal Workers	\$25.00	\$5.35	\$30.35
Structural Iron And Steel Workers	\$30.08	\$7.61	\$37.69
Tapers	\$32.63	\$0.00	\$32.63
Telecommunications Equipment Installers And Repairers - Except Line Installers	\$28.00	\$6.35	\$34.35
Telecommunications Line Installers And Repairers	\$31.03	\$18.73	\$49.76
Tile And Marble Setters	\$27.75	\$6.73	\$34.48

Welders are classified as the trade to which welding is incidental (e.g. welding structural steel is Structural Iron and Steel Worker)

Apprentices – The minimum wage rates for registered apprentices are the rates recognized in the sponsorship agreement for registered apprentices working in the pertinent classification.

For any other specific trade on this project not listed above, contact the Bureau of Labor Standards for further clarification.

Title 26 §1310 requires that a clearly legible statement of all fair minimum wage and benefits rates to be paid the several classes of laborers, workers and mechanics employed on the construction on the public work must be kept posted in a prominent and easily accessible place at the site by each contractor and subcontractor subject to sections 1304 to 1313.

Appeal – Any person affected by the determination of these rates may appeal to the Commissioner of Labor by filing a written notice with the Commissioner stating the specific grounds of the objection within ten (10) days from the filing of these rates.

A true copy

Attest: Scott R. Cotnoir  
Scott R. Cotnoir  
Wage & Hour Director  
Bureau of Labor Standards

NEW HEADQUARTERS BUILDING  
INLAND FISHERIES AND WILDLIFE – EAST CAMPUS  
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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under Owner's separate contracts.
4. Owner-furnished/Contractor-installed (OFCI) products.
5. Owner-furnished/Owner-installed (OFOI) products.
6. Contractor's use of site and premises.
7. Coordination with occupants.
8. Work restrictions.
9. Specification and Drawing conventions.
10. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 DEFINITIONS

- A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

- A. Project Identification: Inland Fisheries and Wildlife Headquarters Building.

1. Project Location: Independence Drive, Augusta, Maine, 04330.

- B. Owner: Bureau of General Services and Maine Department of Inland Fisheries and Wildlife.

1. Bureau of General Services Representative: Brian Keezer.
2. Inland Fisheries and Wildlife Representative: Richard Parker.

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- C. Architects and Engineers: Oak Point Associates, 231 Main Street, Biddeford, Maine 04005.
  - 1. Architect's Representative: Tyler Barter, AIA, Principal, 207-283-0193.
- D. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.
  - 1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
  - 1. The project consists of a 16,500 GSF major renovation of a historical brick 3 story building, two additions totaling 27,000 GSF, and a 8,750 GSF detached storage barn. The construction consists of excavation; utilities; paving; landscaping; concrete foundations; glue-lam and cross laminated timber, metal, and concrete structure; unit masonry; cementitious and stone veneer siding; building insulation; doors, frames, and windows; roofing; interior partitions; finishes; electric traction passenger and service elevator; complete fire suppression; mechanical and plumbing; securing access; instructional technology; public address systems; and incidental work and other work indicated in the contract documents.
- B. Type of Contract:
  - 1. Project will be constructed under a single, fixed fee contract.

1.6 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFICI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
  - 1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
  - 2. Provide for delivery of Owner-furnished products to Project site.
  - 3. Upon delivery, inspect, with Contractor present, delivered items.
    - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
  - 4. Obtain manufacturer's inspections, service, and warranties.
  - 5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
  - 1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
  - 2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.



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3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  1. Limits on Use of Site: Confine construction operations to areas indicated on plans.
  2. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- E. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.8 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
  1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
  2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

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- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
  2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
  3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
  4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.9 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 7:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
1. Weekend Hours: 8:00 a.m. to 5:00 p.m.
  2. Early Morning Hours: As permitted by Owner.
  3. Hours for Utility Shutdowns: Shutdowns to take place outside of normal work hours or on weekend.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
1. Notify Architect and Owner not less than two days in advance of proposed utility interruptions.
  2. Obtain Architect's and Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
1. Notify Architect and Owner not less than two days in advance of proposed disruptive operations.
  2. Obtain Architect's and Owner's written permission before proceeding with disruptive operations.

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- E. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Project site is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with Owner's requirements for background screening of Contractor personnel working on Project site.
  - 1. Maintain list of approved screened personnel with Owner's representative.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
  - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
  - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard.
  - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
  - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
  - 2. Section 014000 "Quality Requirements" for field testing by an independent testing agency.

1.3 DEFINITIONS

- A. Unit price is a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
  - 1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
  - 2. Unit of Measurement: Cubic yard of soil excavated, based on in-place surveys of volume before and after removal.
- B. Unit Price No. 2: Mass rock excavation and replacement with satisfactory soil material in areas outside the limit of soil disturbance indicated.
  - 1. Description: Classified mass rock excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
  - 2. Unit of Measurement: Cubic yard of rock excavated, based on in-place surveys of volume before and after removal.
- C. Unit Price No. 3: Trench rock excavation for areas with pay limits less than 10 feet in width and replacement with satisfactory soil material in areas outside the limit of soil disturbance indicate. These areas may include utility trenches, pits, and footings.
  - 1. Description: Classified trench rock excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
  - 2. Unit of Measurement: Cubic yard of rock excavated, based on survey of in-place surveys volume of before and after removal.

END OF SECTION

## SECTION 012300 – ALTERNATES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

#### 1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

#### 1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other Work of the Contract.
- C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

### PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Replace remainder of Independence Drive to Arsenal Street as indicated on Sitework Drawings.
- B. Alternate No. 2: Provide Generator, installation and testing as indicated on Electrical Drawings.
- C. Alternate No. 3: Reduce interior glass partitions and replace with gypsum board partitions as indicated on Drawings.
- D. Alternate No. 4: Reduce decorative ceilings and replace with suspended acoustical ceilings as indicated on Drawings.

END OF SECTION



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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use form acceptable to Architect.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.

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- b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
  - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
  - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

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1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

- 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

- B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
  - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
  - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on Architect's standard form.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within 10 business days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

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finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use forms acceptable to Architect.

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

- 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
- 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
- 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
- 4. Include costs of labor and supervision directly attributable to the change.
- 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
- 7. Proposal Request Form: Use form acceptable to Architect.

#### 1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on.

#### 1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Owner's name.
    - c. Owner's Project number.
    - d. Name of Architect.

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- e. Architect's Project number.
  - f. Contractor's name and address.
  - g. Date of submittal.
- 2. Arrange schedule of values consistent with format of AIA Document G703.
- 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
  - a. Related Specification Section or division.
  - b. Description of the Work.
  - c. Name of subcontractor.
  - d. Name of manufacturer or fabricator.
  - e. Name of supplier.
  - f. Change Orders (numbers) that affect value.
  - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
    - 1) Labor.
    - 2) Materials.
    - 3) Equipment.
- 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
- 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - a. Differentiate between items stored on-site and items stored off-site.
- 6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
- 7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
- 8. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
- 9. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
- 10. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
- 11. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
- 12. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.



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1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect at each monthly requisition meeting. The period covered by each Application for Payment is one month, ending on the last day of the month.
  - 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
  - 1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
  - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  - 3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.

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- c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
  - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  - 2. When an application shows completion of an item, submit conditional final or full waivers.
  - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  - 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
  - 1. List of subcontractors.
  - 2. Schedule of values.
  - 3. Contractor's construction schedule (preliminary if not final).
  - 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
  - 5. Products list (preliminary if not final).
  - 6. Sustainable design action plans, including preliminary project materials cost data.
  - 7. Schedule of unit prices.
  - 8. Submittal schedule (preliminary if not final).
  - 9. List of Contractor's staff assignments.
  - 10. List of Contractor's principal consultants.
  - 11. Copies of building permits.
  - 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  - 13. Initial progress report.
  - 14. Report of preconstruction conference.
  - 15. Certificates of insurance and insurance policies.
  - 16. Performance and payment bonds.
  - 17. Data needed to acquire Owner's insurance.
- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

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1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
    - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Certification of completion of final punch list items.
  3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  4. Updated final statement, accounting for final changes to the Contract Sum.
  5. AIA Document G706.
  6. AIA Document G706A.
  7. AIA Document G707.
  8. Evidence that claims have been settled.
  9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  10. Final liquidated damages settlement statement.
  11. Proof that taxes, fees, and similar obligations are paid.
  12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. RFIs.
  - 3. Coordination drawings.
  - 4. Digital project management procedures.
  - 5. Project meetings.
- B. Related Requirements:
  - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.

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- C. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
  - 1. Post copies of list in Project meeting room, in temporary field office, and in prominent location in built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Preinstallation conferences.
  - 7. Project closeout activities.
  - 8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

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Note: Architect's electronic files will not be available for use in coordination drawings.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
  - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
  - b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
  - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, plumbing, fire protection, kitchen, and electrical systems.
  - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
  - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
  - f. Indicate required installation sequences.
  - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, kitchen, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
  - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.

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- b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts, air handlers, terminal units, boiler plant equipment, control panels, and electrical distribution equipment.
  - c. Fire-rated enclosures around ductwork.
- 7. Electrical Work: Show the following:
  - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
  - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations, including dimensions.
  - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations, including dimensions.
  - d. Location and dimensions of pull boxes and junction boxes, dimensioned from column center lines.
- 8. Fire-Protection System: Show the following:
  - a. Locations and dimensions of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
- 9. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
  - 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  - 2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and PDF format.

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  - 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
  - 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  - 1. Project name.
  - 2. Owner name.

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3. Owner's Project number.
  4. Name of Architect.
  5. Architect's Project number.
  6. Date.
  7. Name of Contractor.
  8. RFI number, numbered sequentially.
  9. RFI subject.
  10. Specification Section number and title and related paragraphs, as appropriate.
  11. Drawing number and detail references, as appropriate.
  12. Field dimensions and conditions, as appropriate.
  13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  14. Contractor's signature.
  15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow three days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.



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- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
  - 1. Project name.
  - 2. Name and address of Contractor.
  - 3. Name and address of Architect.
  - 4. RFI number, including RFIs that were returned without action or withdrawn.
  - 5. RFI description.
  - 6. Date the RFI was submitted.
  - 7. Date Architect's response was received.
  - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's CAD drawings will be provided by Architect for Contractor's use during construction.
  - 1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
  - 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
  - 3. Digital Drawing Software Program: Contract Drawings are available in AutoCad 2022.
  - 4. Contractor shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.
    - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.
  - 5. The following digital data files will be furnished for each appropriate discipline:
    - a. Floor plans.
    - b. Reflected ceiling plans.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
  - 1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  - 2. Name file with submittal number or other unique identifier, including revision identifier.
  - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

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1.9 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Contractor will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
  - 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Responsibilities and personnel assignments.
    - b. Tentative construction schedule.
    - c. Phasing.
    - d. Critical work sequencing and long lead items.
    - e. Designation of key personnel and their duties.
    - f. Lines of communications.
    - g. Use of web-based Project software.
    - h. Procedures for processing field decisions and Change Orders.
    - i. Procedures for RFIs.
    - j. Procedures for testing and inspecting.
    - k. Procedures for processing Applications for Payment.
    - l. Distribution of the Contract Documents.
    - m. Submittal procedures.
    - n. Preparation of Record Documents.
    - o. Use of the premises and existing building.
    - p. Work restrictions.
    - q. Working hours.
    - r. Owner's occupancy requirements.
    - s. Responsibility for temporary facilities and controls.
    - t. Procedures for moisture and mold control.
    - u. Procedures for disruptions and shutdowns.
    - v. Construction waste management and recycling.
    - w. Parking availability.
    - x. Office, work, and storage areas.
    - y. Equipment deliveries and priorities.
    - z. First aid.
    - aa. Security.
    - bb. Progress cleaning.

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3. Minutes: Contractor will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility requirements.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written instructions.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.
  3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 30 days prior to the scheduled date of Substantial Completion.

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1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of Record Documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Procedures for completing and archiving web-based Project software site data files.
    - d. Submittal of written warranties.
    - e. Requirements for preparing operations and maintenance data.
    - f. Requirements for delivery of material samples, attic stock, and spare parts.
    - g. Requirements for demonstration and training.
    - h. Preparation of Contractor's punch list.
    - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - j. Submittal procedures.
    - k. Responsibility for removing temporary facilities and controls.
  4. Minutes: Contractor will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at biweekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
  2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.

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- 3) Status of submittals.
  - 4) Deliveries.
  - 5) Off-site fabrication.
  - 6) Access.
  - 7) Site use.
  - 8) Temporary facilities and controls.
  - 9) Progress cleaning.
  - 10) Quality and work standards.
  - 11) Status of correction of deficient items.
  - 12) Field observations.
  - 13) Status of RFIs.
  - 14) Status of Proposal Requests.
  - 15) Pending changes.
  - 16) Status of Change Orders.
  - 17) Pending claims and disputes.
  - 18) Documentation of information for payment requests.
4. Minutes: Contractor will record and distribute the meeting minutes to each party present and to parties requiring information.
    - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - c. Review present and future needs of each contractor present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.

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- 3) Status of submittals.
  - 4) Deliveries.
  - 5) Off-site fabrication.
  - 6) Access.
  - 7) Site use.
  - 8) Temporary facilities and controls.
  - 9) Work hours.
  - 10) Hazards and risks.
  - 11) Progress cleaning.
  - 12) Quality and work standards.
  - 13) Status of RFIs.
  - 14) Proposal Requests.
  - 15) Change Orders.
  - 16) Pending changes.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Startup construction schedule.
  - 2. Contractor's Construction Schedule.
  - 3. Construction schedule updating reports.
  - 4. Site condition reports.
  - 5. Unusual event reports.
- B. Related Requirements:
  - 1. Section 014000 "Quality Requirements" for schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. Event: The starting or ending point of an activity.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Format for Submittals: Submit required submittals in the following format:

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1. Working electronic copy of schedule file.
  2. PDF file.
- C. Startup construction schedule.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Unusual Event Reports: Submit at time of unusual event.
- H. Qualification Data: For scheduling consultant.

1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from entities involved.
  2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  2. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.



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3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Temporary enclosure and space conditioning.
    - c. Permanent space enclosure.
    - d. Completion of electrical installation.
    - e. Substantial Completion.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
  2. Unanswered Requests for Information.
  3. Rejected or unreturned submittals.
  4. Notations on returned submittals.
  5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  3. As the Work progresses, indicate Final Completion percentage for each activity.
- H. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.

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2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Periodic construction photographs.
  - 3. Final completion construction photographs.
- B. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
  - 2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- C. Digital Photographs: Submit image files within three days of taking photographs.
  - 1. Submit photos by uploading to web-based project software site. Include copy of key plan indicating each photograph's location and direction.
  - 2. Identification: Provide the following information with each image description in web-based project software site:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of location, vantage point, and direction.
    - g. Unique sequential identifier keyed to accompanying key plan.

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1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time and GPS location data from camera.
- D. File Names: Name media files with date, Project area, and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of excavation, commencement of demolition, and starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
  - 1. Flag construction limits before taking construction photographs.
  - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
  - 3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
  - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take 100 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
4. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
5. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  2. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

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- a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
3. Format: Arrange the following information in a tabular format:
  - a. Scheduled date for first submittal.
  - b. Specification Section number and title.
  - c. Submittal Category: Action; informational.
  - d. Name of subcontractor.
  - e. Description of the Work covered.
  - f. Scheduled date for Architect's final release or approval.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number and specification section.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

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1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
    - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
  - 2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  - 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  - 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  - 1. Note date and content of previous submittal.
  - 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.

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3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with reviewed notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
  1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.



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- f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  - 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
    - a. Three opaque copies of each submittal. Architect will retain one copy; remainder will be returned.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
  - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
  - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
  - 4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
  - 5. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
  - 6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  - 7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

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1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
  5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
  6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
  2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
  3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
  4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

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5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

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1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
  - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
  - 2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

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1. Mockups are used for one or more of the following:
    - a. Verify selections made under Sample submittals.
    - b. Demonstrate aesthetic effects.
    - c. Demonstrate the qualities of products and workmanship.
    - d. Demonstrate successful installation of interfaces between components and systems.
    - e. Perform preconstruction testing to determine system performance.
  2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
  3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.
- 1.4 DELEGATED DESIGN SERVICES
- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be

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designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- C. Qualification Data: For Contractor's quality-control personnel.
- D. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
  - 2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- E. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- F. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.

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6. Number of tests and inspections required.
  7. Time schedule or time span for tests and inspections.
  8. Requirements for obtaining samples.
  9. Unique characteristics of each quality-control service.
- G. Reports: Prepare and submit certified written reports and documents as specified.
- H. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
  2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.



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1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
  2. Project title and number.
  3. Name, address, telephone number, and email address of testing agency.
  4. Dates and locations of samples and tests or inspections.
  5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement of whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement of whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.

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1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
  - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- F. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups of size indicated.
  - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
  - 5. Demonstrate the proposed range of aesthetic effects and workmanship.

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6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
  - a. Allow seven days for initial review and each re-review of each mockup.
7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.10 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
  1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Engage a qualified testing agency to perform quality-control services.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- C. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  1. Notify Architect, Commissioning Authority, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.

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5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- F. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  6. Security and protection for samples and for testing and inspection equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
  2. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  - 1. Date test or inspection was conducted.
  - 2. Description of the Work tested or inspected.
  - 3. Date test or inspection results were transmitted to Architect.
  - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's authorities' having jurisdiction reference during normal working hours.
  - 1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

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SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
  - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

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- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. AABC - Associated Air Balance Council; [www.aabc.com](http://www.aabc.com).
  2. AAMA - American Architectural Manufacturers Association; (see FGIA).
  3. AAPFCO - Association of American Plant Food Control Officials; [www.aapfco.org](http://www.aapfco.org).
  4. AASHTO - American Association of State Highway and Transportation Officials; [www.transportation.org](http://www.transportation.org).
  5. AATCC - American Association of Textile Chemists and Colorists; [www.aatcc.org](http://www.aatcc.org).
  6. ABMA - American Bearing Manufacturers Association; [www.americanbearings.org](http://www.americanbearings.org).
  7. ABMA - American Boiler Manufacturers Association; [www.abma.com](http://www.abma.com).
  8. ACI - American Concrete Institute; [www.concrete.org](http://www.concrete.org).
  9. ACP - American Clean Power; (Formerly: American Wind Energy Association); [www.cleanpower.org](http://www.cleanpower.org).
  10. ACPA - American Concrete Pipe Association; [www.concretepipe.org](http://www.concretepipe.org).
  11. AEIC - Association of Edison Illuminating Companies, Inc. (The); [www.aeic.org](http://www.aeic.org).
  12. AF&PA - American Forest & Paper Association; [www.afandpa.org](http://www.afandpa.org).
  13. AGA - American Gas Association; [www.aga.org](http://www.aga.org).
  14. AHAM - Association of Home Appliance Manufacturers; [www.aham.org](http://www.aham.org).
  15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); [www.ahrinet.org](http://www.ahrinet.org).
  16. AI - Asphalt Institute; [www.asphaltinstitute.org](http://www.asphaltinstitute.org).
  17. AIA - American Institute of Architects (The); [www.aia.org](http://www.aia.org).
  18. AISC - American Institute of Steel Construction; [www.aisc.org](http://www.aisc.org).
  19. AISI - American Iron and Steel Institute; [www.steel.org](http://www.steel.org).
  20. AITC - American Institute of Timber Construction; (see PLIB).
  21. AMCA - Air Movement and Control Association International, Inc.; [www.amca.org](http://www.amca.org).
  22. AMPP - Association for Materials Protection and Performance; [www.ampp.org](http://www.ampp.org).
  23. ANSI - American National Standards Institute; [www.ansi.org](http://www.ansi.org).
  24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); [www.analyzeseeds.com](http://www.analyzeseeds.com).
  25. APA - APA - The Engineered Wood Association; [www.apawood.org](http://www.apawood.org).

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26. APA - Architectural Precast Association; [www.archprecast.org](http://www.archprecast.org).
27. API - American Petroleum Institute; [www.api.org](http://www.api.org).
28. ARMA - Asphalt Roofing Manufacturers Association; [www.asphaltroofing.org](http://www.asphaltroofing.org).
29. ASA - Acoustical Society of America; [www.acousticalsociety.org](http://www.acousticalsociety.org).
30. ASCE - American Society of Civil Engineers; [www.asce.org](http://www.asce.org).
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; [www.ashrae.org](http://www.ashrae.org).
33. ASME - ASME International; [**American Society of Mechanical Engineers (The)**]; [www.asme.org](http://www.asme.org).
34. ASSE - ASSE International; (American Society of Sanitary Engineering); [www.asse-plumbing.org](http://www.asse-plumbing.org).
35. ASSP - American Society of Safety Professionals; [www.assp.org](http://www.assp.org).
36. ASTM - ASTM International; [www.astm.org](http://www.astm.org).
37. ATIS - Alliance for Telecommunications Industry Solutions; [www.atis.org](http://www.atis.org).
38. AVIXA - Audiovisual and Integrated Experience Association; [www.avixa.org](http://www.avixa.org).
39. AWI - Architectural Woodwork Institute; [www.awinet.org](http://www.awinet.org).
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; [www.awmac.com](http://www.awmac.com).
41. AWWA - American Water Works Association; [www.awwa.org](http://www.awwa.org).
42. AWS - American Welding Society; [www.aws.org](http://www.aws.org).
43. AWWA - American Water Works Association; [www.awwa.org](http://www.awwa.org).
44. BHMA - Builders Hardware Manufacturers Association; [www.buildershardware.com](http://www.buildershardware.com).
45. BIA - Brick Industry Association (The); [www.gobrick.com](http://www.gobrick.com).
46. BICSI - BICSI, Inc.; [www.bicsi.org](http://www.bicsi.org).
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; [www.bifma.org](http://www.bifma.org).
48. BISSC - Baking Industry Sanitation Standards Committee; [www.bissc.org](http://www.bissc.org).
49. BWF - Badminton World Federation; [www.bwfbadminton.com](http://www.bwfbadminton.com).
50. CARB - California Air Resources Board; [www.arb.ca.gov](http://www.arb.ca.gov).
51. CDA - Copper Development Association Inc.; [www.copper.org](http://www.copper.org).
52. CE - Conformite Europeenne (European Commission); [www.ec.europa.eu/growth/single-market/ce-marking](http://www.ec.europa.eu/growth/single-market/ce-marking).
53. CEA - Canadian Electricity Association; [www.electricity.ca](http://www.electricity.ca).
54. CFFA - Chemical Fabrics and Film Association, Inc.; [www.chemicalfabricsandfilm.com](http://www.chemicalfabricsandfilm.com).
55. CFSEI - Cold-Formed Steel Engineers Institute; [www.cfsei.org](http://www.cfsei.org).
56. CGA - Compressed Gas Association; [www.cganet.com](http://www.cganet.com).
57. CIMA - Cellulose Insulation Manufacturers Association; [www.cellulose.org](http://www.cellulose.org).
58. CISCA - Ceilings & Interior Systems Construction Association; [www.cisca.org](http://www.cisca.org).
59. CISPI - Cast Iron Soil Pipe Institute; [www.cispi.org](http://www.cispi.org).
60. CLFMI - Chain Link Fence Manufacturers Institute; [www.chainlinkinfo.org](http://www.chainlinkinfo.org).
61. CPA - Composite Panel Association; [www.compositepanel.org](http://www.compositepanel.org).
62. CRI - Carpet and Rug Institute (The); [www.carpet-rug.org](http://www.carpet-rug.org).
63. CRRC - Cool Roof Rating Council; [www.coolroofs.org](http://www.coolroofs.org).
64. CRSI - Concrete Reinforcing Steel Institute; [www.crsi.org](http://www.crsi.org).
65. CSA - CSA Group; [www.csagroup.org](http://www.csagroup.org).
66. CSI - Cast Stone Institute; [www.caststone.org](http://www.caststone.org).
67. CSI - Construction Specifications Institute (The); [www.csiresources.org](http://www.csiresources.org).
68. CSSB - Cedar Shake & Shingle Bureau; [www.cedarbureau.org](http://www.cedarbureau.org).
69. CTA - Consumer Technology Association; [www.cta.tech](http://www.cta.tech).



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70. CTI - Cooling Technology Institute; [www.coolingtechnology.org](http://www.coolingtechnology.org).
71. DASMA - Door and Access Systems Manufacturers Association; [www.dasma.com](http://www.dasma.com).
72. DHA - Decorative Hardwoods Association; [www.decorativehardwoods.org](http://www.decorativehardwoods.org).
73. DHI - Door and Hardware Institute; [www.dhi.org](http://www.dhi.org).
74. ECIA - Electronic Components Industry Association; [www.ecianow.org](http://www.ecianow.org).
75. EIMA - EIFS Industry Members Association; [www.eima.com](http://www.eima.com).
76. EJMA - Expansion Joint Manufacturers Association, Inc.; [www.ejma.org](http://www.ejma.org).
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; [www.esda.org](http://www.esda.org).
78. ESTA - Entertainment Services and Technology Association; [www.esta.org](http://www.esta.org).
79. EVO - Efficiency Valuation Organization; [www.evo-world.org](http://www.evo-world.org).
80. FCI - Fluid Controls Institute; [www.fluidcontrolsinstitute.org](http://www.fluidcontrolsinstitute.org).
81. FGIA - Fenestration and Glazing Industry Alliance; <https://fgiaonline.org>.
82. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); [www.fiba.com](http://www.fiba.com).
83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); [www.fivb.org](http://www.fivb.org).
84. FM Approvals - FM Approvals LLC; [www.fmapprovals.com](http://www.fmapprovals.com).
85. FM Global - FM Global; [www.fmglobal.com](http://www.fmglobal.com).
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; [www.floridarroof.com](http://www.floridarroof.com).
87. FSA - Fluid Sealing Association; [www.fluidsealing.com](http://www.fluidsealing.com).
88. FSC - Forest Stewardship Council U.S.; [www.fscus.org](http://www.fscus.org).
89. GA - Gypsum Association; [www.gypsum.org](http://www.gypsum.org).
90. GS - Green Seal; [www.greenseal.org](http://www.greenseal.org).
91. HI - Hydraulic Institute; [www.pumps.org](http://www.pumps.org).
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; [www.iapsc.org](http://www.iapsc.org).
94. IAS - International Accreditation Service; [www.iasonline.org](http://www.iasonline.org).
95. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
96. ICEA - Insulated Cable Engineers Association, Inc.; [www.icea.net](http://www.icea.net).
97. ICPA - International Cast Polymer Association (The); [www.theicpa.com](http://www.theicpa.com).
98. ICRI - International Concrete Repair Institute, Inc.; [www.icri.org](http://www.icri.org).
99. IEC - International Electrotechnical Commission; [www.iec.ch](http://www.iec.ch).
100. IEEE SA - IEEE Standards Association; <https://standards.ieee.org>.
101. IES - Illuminating Engineering Society; [www.ies.org](http://www.ies.org).
102. IEST - Institute of Environmental Sciences and Technology; [www.iest.org](http://www.iest.org).
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; [www.igshpa.org](http://www.igshpa.org).
105. ILI - Indiana Limestone Institute of America, Inc.; [www.iliai.com](http://www.iliai.com).
106. Intertek - Intertek Group; [www.intertek.com](http://www.intertek.com).
107. ISA - International Society of Automation (The); [www.isa.org](http://www.isa.org).
108. ISFA - International Surface Fabricators Association; [www.isfanow.org](http://www.isfanow.org).
109. ISO - International Organization for Standardization; [www.iso.org](http://www.iso.org).
110. ITU - International Telecommunication Union; [www.itu.int](http://www.itu.int).
111. KCMA - Kitchen Cabinet Manufacturers Association; [www.kcma.org](http://www.kcma.org).
112. LPI - Lightning Protection Institute; [www.lightning.org](http://www.lightning.org).
113. MBMA - Metal Building Manufacturers Association; [www.mbma.com](http://www.mbma.com).
114. MCA - Metal Construction Association; [www.metalconstruction.org](http://www.metalconstruction.org).
115. MFMA - Maple Flooring Manufacturers Association, Inc.; [www.maplefloor.org](http://www.maplefloor.org).
116. MFMA - Metal Framing Manufacturers Association, Inc.; [www.metalframingmfg.org](http://www.metalframingmfg.org).

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117. MHI - Material Handling Industry; [www.mhi.org](http://www.mhi.org).
118. MMPA - Moulding & Millwork Producers Association; [www.wmmpa.com](http://www.wmmpa.com).
119. MPI - Master Painters Institute; [www.paintinfo.com](http://www.paintinfo.com).
120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; [www.msshq.org](http://www.msshq.org).
121. NAAMM - National Association of Architectural Metal Manufacturers; [www.naamm.org](http://www.naamm.org).
122. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
123. NADCA - National Air Duct Cleaners Association; [www.nadca.com](http://www.nadca.com).
124. NAIMA - North American Insulation Manufacturers Association; [www.insulationinstitute.org](http://www.insulationinstitute.org).
125. NALP - National Association of Landscape Professionals; [www.landscapeprofessionals.org](http://www.landscapeprofessionals.org).
126. NBGQA - National Building Granite Quarries Association, Inc.; [www.nbgqa.com](http://www.nbgqa.com).
127. NBI - New Buildings Institute; [www.newbuildings.org](http://www.newbuildings.org).
128. NCAA - National Collegiate Athletic Association (The); [www.ncaa.org](http://www.ncaa.org).
129. NCMA - National Concrete Masonry Association; [www.ncma.org](http://www.ncma.org).
130. NEBB - National Environmental Balancing Bureau; [www.nebb.org](http://www.nebb.org).
131. NECA - National Electrical Contractors Association; [www.necanet.org](http://www.necanet.org).
132. NeLMA - Northeastern Lumber Manufacturers Association; [www.nelma.org](http://www.nelma.org).
133. NEMA - National Electrical Manufacturers Association; [www.nema.org](http://www.nema.org).
134. NETA - InterNational Electrical Testing Association; [www.netaworld.org](http://www.netaworld.org).
135. NFHS - National Federation of State High School Associations; [www.nfhs.org](http://www.nfhs.org).
136. NFPA - National Fire Protection Association; [www.nfpa.org](http://www.nfpa.org).
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; [www.nfrc.org](http://www.nfrc.org).
139. NGA - National Glass Association; [www.glass.org](http://www.glass.org).
140. NHLA - National Hardwood Lumber Association; [www.nhla.com](http://www.nhla.com).
141. NLGA - National Lumber Grades Authority; [www.nlga.org](http://www.nlga.org).
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; [www.nomma.org](http://www.nomma.org).
144. NRCA - National Roofing Contractors Association; [www.nrca.net](http://www.nrca.net).
145. NRMCA - National Ready Mixed Concrete Association; [www.nrmca.org](http://www.nrmca.org).
146. NSF - NSF International; [www.nsf.org](http://www.nsf.org).
147. NSI - Natural Stone Institute; [www.naturalstoneinstitute.org](http://www.naturalstoneinstitute.org).
148. NSPE - National Society of Professional Engineers; [www.nspe.org](http://www.nspe.org).
149. NSSGA - National Stone, Sand & Gravel Association; [www.nssga.org](http://www.nssga.org).
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); [www.ntma.com](http://www.ntma.com).
151. NWFA - National Wood Flooring Association; [www.nwfa.org](http://www.nwfa.org).
152. NWRA - National Waste & Recycling Association; [www.wasterecycling.org](http://www.wasterecycling.org).
153. PCI - Precast/Prestressed Concrete Institute; [www.pci.org](http://www.pci.org).
154. PDI - Plumbing & Drainage Institute; [www.pdionline.org](http://www.pdionline.org).
155. PLASA - PLASA; [www.plasa.org](http://www.plasa.org).
156. PLIB - Pacific Lumber Inspection Bureau; [www.plib.org](http://www.plib.org).
157. PVCPA - Uni-Bell PVC Pipe Association; [www.uni-bell.org](http://www.uni-bell.org).
158. RCSC - Research Council on Structural Connections; [www.boltcouncil.org](http://www.boltcouncil.org).
159. RFCI - Resilient Floor Covering Institute; [www.rfci.com](http://www.rfci.com).
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; [www.sae.org](http://www.sae.org).
162. SCTE - Society of Cable Telecommunications Engineers; [www.scte.org](http://www.scte.org).

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163. SDI - Steel Deck Institute; [www.sdi.org](http://www.sdi.org).
164. SDI - Steel Door Institute; [www.steeldoor.org](http://www.steeldoor.org).
165. SEFA - Scientific Equipment and Furniture Association (The); [www.sefalabs.com](http://www.sefalabs.com).
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
167. SIA - Security Industry Association; [www.securityindustry.org](http://www.securityindustry.org).
168. SJI - Steel Joist Institute; [www.steeljoist.org](http://www.steeljoist.org).
169. SMA - Screen Manufacturers Association; [www.smainfo.org](http://www.smainfo.org).
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; [www.smacna.org](http://www.smacna.org).
171. SMPTE - Society of Motion Picture and Television Engineers; [www.smpte.org](http://www.smpte.org).
172. SPFA - Spray Polyurethane Foam Alliance; [www.sprayfoam.org](http://www.sprayfoam.org).
173. SPIB - Southern Pine Inspection Bureau; [www.spib.org](http://www.spib.org).
174. SPRI - Single Ply Roofing Industry; [www.spri.org](http://www.spri.org).
175. SRCC - Solar Rating & Certification Corporation; [www.solar-rating.org](http://www.solar-rating.org).
176. SSINA - Specialty Steel Industry of North America; [www.ssina.com](http://www.ssina.com).
177. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
178. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; [www.steeltank.com](http://www.steeltank.com).
179. SWI - Steel Window Institute; [www.steelwindows.com](http://www.steelwindows.com).
180. SWPA - Submersible Wastewater Pump Association; [www.swpa.org](http://www.swpa.org).
181. TCA - Tilt-Up Concrete Association; [www.tilt-up.org](http://www.tilt-up.org).
182. TCNA - Tile Council of North America, Inc.; [www.tcnatile.com](http://www.tcnatile.com).
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; [www.kbcdco.tema.org](http://www.kbcdco.tema.org).
184. TIA - Telecommunications Industry Association (The); [www.tiaonline.org](http://www.tiaonline.org).
185. TMS - The Masonry Society; [www.masonrysociety.org](http://www.masonrysociety.org).
186. TPI - Truss Plate Institute; [www.tpinst.org](http://www.tpinst.org).
187. TPI - Turfgrass Producers International; [www.turfgrasssod.org](http://www.turfgrasssod.org).
188. TRI - Tile Roofing Industry Alliance; [www.tilerroofing.org](http://www.tilerroofing.org).
189. ULSE - UL Standards & Engagement Inc.; [www.ulse.org](http://www.ulse.org).
190. UL - UL Solutions Inc.; [www.ul.com](http://www.ul.com).
191. USAV - USA Volleyball; [www.usavolleyball.org](http://www.usavolleyball.org).
192. USGBC - U.S. Green Building Council; [www.usgbc.org](http://www.usgbc.org).
193. USITT - United States Institute for Theatre Technology, Inc.; [www.usitt.org](http://www.usitt.org).
194. WA - Wallcoverings Association; [www.wallcoverings.org](http://www.wallcoverings.org).
195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
196. WCMA - Window Covering Manufacturers Association; [www.wcmanet.org](http://www.wcmanet.org).
197. WDMA - Window & Door Manufacturers Association; [www.wdma.com](http://www.wdma.com).
198. WI - Woodwork Institute; [www.woodworkinstitute.com](http://www.woodworkinstitute.com).
199. WSRCA - Western States Roofing Contractors Association; [www.wsrca.com](http://www.wsrca.com).
200. WWPA - Western Wood Products Association; [www.wwpa.org](http://www.wwpa.org).

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; [www.din.de](http://www.din.de).
2. IAPMO - International Association of Plumbing and Mechanical Officials; [www.iapmo.org](http://www.iapmo.org).
3. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
4. ICC-ES - ICC Evaluation Service, LLC; [www.icc-es.org](http://www.icc-es.org).

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D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - U.S. Consumer Product Safety Commission; [www.cpsc.gov](http://www.cpsc.gov).
2. DOC - U.S. Department of Commerce; [www.commerce.gov](http://www.commerce.gov).
3. DOD - U.S. Department of Defense; [www.defense.gov](http://www.defense.gov).
4. DOE - U.S. Department of Energy; [www.energy.gov](http://www.energy.gov).
5. DOJ - U.S. Department of Justice; [www.ojp.usdoj.gov](http://www.ojp.usdoj.gov).
6. DOS - U.S. Department of State; [www.state.gov](http://www.state.gov).
7. EPA - United States Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
8. FAA - Federal Aviation Administration; [www.faa.gov](http://www.faa.gov).
9. GPO - U.S. Government Publishing Office; [www.gpo.gov](http://www.gpo.gov).
10. GSA - U.S. General Services Administration; [www.gsa.gov](http://www.gsa.gov).
11. HUD - U.S. Department of Housing and Urban Development; [www.hud.gov](http://www.hud.gov).
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; [www.lbl.gov/](http://www.lbl.gov/).
13. NIST - National Institute of Standards and Technology; [www.nist.gov](http://www.nist.gov).
14. OSHA - Occupational Safety & Health Administration; [www.osha.gov](http://www.osha.gov).
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; [www.trb.org](http://www.trb.org).
16. USACE - U.S. Army Corps of Engineers; [www.usace.army.mil](http://www.usace.army.mil).
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; [www.ars.usda.gov](http://www.ars.usda.gov).
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; [www.usda.gov](http://www.usda.gov).
19. USP - U.S. Pharmacopeial Convention; [www.usp.org](http://www.usp.org).
20. USPS - United States Postal Service; [www.usps.com](http://www.usps.com).

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; [www.govinfo.gov](http://www.govinfo.gov).
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; [www.dsp.dla.mil/Specs-Standards/](http://www.dsp.dla.mil/Specs-Standards/).
3. DSCC - Defense Supply Center Columbus; (see FS).
4. FED-STD - Federal Standard; (see FS).
5. FS - Federal Specification; Available from DLA Document Services; [www.dsp.dla.mil/Specs-Standards/](http://www.dsp.dla.mil/Specs-Standards/).
  - a. Available from Defense Standardization Program; [www.dsp.dla.mil](http://www.dsp.dla.mil).
  - b. Available from U.S. General Services Administration; [www.gsa.gov](http://www.gsa.gov).
  - c. Available from National Institute of Building Sciences/Whole Building Design Guide; [www.wbdg.org](http://www.wbdg.org).
6. MILSPEC - Military Specifications and Standards; (see DOD).
7. USAB - United States Access Board; [www.access-board.gov](http://www.access-board.gov).
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

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F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); [www.bhgs.dca.ca.gov](http://www.bhgs.dca.ca.gov).
3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; [www.oal.ca.gov/publications/ccr/](http://www.oal.ca.gov/publications/ccr/).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; [www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx](http://www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx).
5. CPUC; California Public Utilities Commission; [www.cpuc.ca.gov](http://www.cpuc.ca.gov).
6. SCAQMD; South Coast Air Quality Management District; [www.aqmd.gov](http://www.aqmd.gov).
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; <https://tfsweb.tamu.edu/>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 014339 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.2 DEFINITIONS

- A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements or part of permanent construction, consisting of multiple products, assemblies, and subassemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior mockups.
2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
3. Review locations and extent of mockups.
4. Review testing procedures to be performed on mockups.
5. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and maintain schedule for the Work.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Shop Drawings: For integrated exterior mockups.

1. Include plans, elevations, sections, and mounting attachment and support details.
2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
3. Include site location drawing indicating orientation of mockup.

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4. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.
- C. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Build mockups to do the following:
  1. Verify selections made under Sample submittals.
  2. Demonstrate aesthetic effects.
  3. Demonstrate the qualities of products and workmanship.
  4. Demonstrate acceptable coordination between components and systems.
  5. Perform preconstruction testing, such as window air- and water-leakage testing.
- B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.
  1. Build mockups of size indicated.
  2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
  4. Demonstrate the proposed range of aesthetic effects and workmanship.
  5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  6. Demolish and remove mockups when directed unless otherwise indicated.
- C. Notifications:
  1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
  2. Notify Architect 14 days in advance of the dates and times when mockups will be tested.
  3. Allow seven days for initial review and each re-review of each mockup.
- D. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.
  1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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1.6 COORDINATION

- A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design support structure for free-standing mockups.
- B. Structural Performance:
  - 1. Seismic Performance: Mockups and support structure to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
  - 2. Wind Loads: As indicated on Drawings.
- C. Mockup Testing Performance Requirements: Perform tests using design pressures and performance criteria indicated for assemblies and products that are specified in other Sections and incorporated into integrated exterior mockups.

2.2 INTEGRATED EXTERIOR MOCKUPS

- A. Construct integrated exterior mockups according to approved mockup Shop Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.
- B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.
- C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.
- D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.
- E. The Work of integrated exterior mockups includes, but is not limited to, the following:
  - 1. Cold-formed metal framing and sheathing.
  - 2. Air and weather barriers.
  - 3. Thermal insulation.
  - 4. Through-wall flashing.
  - 5. Flashing and sheet metal trim.
  - 6. Joint sealants.
  - 7. Metal wall panels.
  - 8. Glazed storefront.



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9. Aluminum windows.
  10. Glazing.
  11. Fiber cement siding.
- F. Photographic Documentation: Document construction of integrated exterior mockups with photographs in accordance with Section 013233 "Photographic Documentation." Provide photographs showing details of interface of different materials and assemblies.
1. Document testing procedures, including water leakage and other deficiencies. Photograph modifications to component interfaces intended to correct deficiencies.
- G. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's approval for modifications.
- H. Retain approved mockups constructed in place. Incorporate fully into the Work.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 014535 - SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- A. Perform Special Inspections in accordance with the Schedule of Special Inspections and Chapter 17 of ICC IBC. The Schedule of Special Inspections are included as an attachment to this specification. Special Inspections are to be performed by an independent third party and are intended to ensure that the work of the Prime Contractor is in accordance with the Contract Documents and applicable building codes.

1.3 DEFINITIONS

- A. Continuous Special Inspections: Continuous Special Inspections is the constant monitoring of specific tasks by a special inspector. These inspections must be carried out continuously over the duration of the particular tasks
- B. Perform: Perform these Special Inspections tasks for each welded joint or member.
- C. Observe: Observe these Special Inspections items on a periodic daily basis. Operations need not be delayed pending these inspections.
- D. Special Inspector (SI): A qualified person retained by the Contractor and approved by the Owner as having the competence necessary to inspect a particular type of construction requiring Special Inspections. The SI must be an independent third party hired directly by the Prime Contractor.
- E. Associate Special Inspector (ASI): A qualified person who assists the SI in performing Special Inspections but must perform inspection under the direct supervision of the SI and cannot perform inspections without the SI on site.
- F. Third Party: A Special inspector must not be an employee of the Contractor or of any Sub-Contractor performing the work to be inspected.
- G. Special Inspector of Record (SIOR): A licensed engineer in responsible charge of supervision of all special inspectors for the project and approved by the Owner. The SIOR must be an independent third party entity hired directly by the Prime Contractor.
- H. Contractor's Quality Control (QC) Manager: An individual retained by the Prime Contractor and qualified in accordance with the Section 01 40 00 QUALITY REQUIREMENTS having the overall responsibility for the Contractor's QC organization.

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- I. Structural Engineer of Record (SER): A registered design professional contracted by the Owner as an A/E responsible for the overall design and review of submittal documents prepared by others. The SER is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws in the state in which the design professional works. The SER is also referred to as the Engineer of Record (EOR) in design code documents.
- J. Schedule of Special Inspections (SSI): A schedule which lists each of the required Special Inspections, the extent to which each Special Inspection is to be performed, and the required frequency for each in accordance with ICC IBC Chapter 17. This schedule is included at the end of this specification.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Preconstruction Submittals:
  - 1. SIOR Letter of Acceptance.
  - 2. Special Inspections Project Manual.
  - 3. Special Inspections Agency’s Written NDT Practices with method and evidence of regular equipment calibration where applicable.
- C. Test Reports:
  - 1. Special Inspections Daily Reports.
  - 2. Special Inspections Biweekly Reports.
- D. Certificates:
  - 1. AISC Certified Steel Fabricator
  - 2. Certificate of Compliance
  - 3. Special Inspector Qualifications
  - 4. Qualification Records for NDT technicians

1.5 SPECIAL INSPECTOR QUALIFICATIONS

- A. Submit qualifications for each special inspector and the special inspector of record.
  - 1. Steel Construction and High Strength Bolting
    - a. Special Inspector:
      - 1) ICC Structural Steel and Bolting Special Inspector certificate with one year of related experience, or
      - 2) Licensed Professional Engineer with three years of related experience.
    - b. Associate Special Inspector: Engineer-in-Training with one year of related experience.

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2. Welding Structural Steel
  - a. Special Inspector:
    - 1) ICC Structural Welding Special Inspector certificate with one year of related experience, or
    - 2) b. AWS Certified Welding Inspector
  - b. Associate Special Inspector: AWS Certified Associate Welding Inspector
3. Nondestructive Testing of Welds:
  - a. Special Inspector: NDT Level III Certificate.
  - b. Associate Special Inspector: NDT Level II Certificate plus one year of related experience.
4. Cold Formed Steel Framing:
  - a. Special Instructor:
    - 1) ICC Structural Steel and Bolting Special Inspector certificate with one year of related experience, or
    - 2) ICC Commercial Building Inspector with one year of experience, or
    - 3) Licensed Professional Engineer with three years related experience
  - b. Associate Special Inspector: Engineer-In-Training with one year of related experience.
5. Concrete Construction:
  - a. Special Inspector:
    - 1) ICC Reinforced Concrete Special Inspector Certificate with one year of related experience, or
    - 2) ACI Concrete Construction Special Inspector, or
    - 3) Licensed Professional Engineer with three years of related experience
  - b. Associate Special Instructor:
    - 1) ACI Concrete Construction Special Inspector in Training, or
    - 2) Engineer-In-Training with one year of related experience
6. Masonry Construction:
  - a. Special Inspector:
    - 1) ICC Structural Masonry Special Inspector Certificate with one year of related experience, or
    - 2) Licensed Professional Engineer with three years of related experience.

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- b. Associate Special Inspector: Engineer-in-Training with one year experience of related experience.
- 7. Wood:
  - a. Special Inspector:
    - 1) ICC Commercial Building Inspector Certificate with one year of related experience, or
    - 2) ICC Residential Building Inspector with one year of experience, or
    - 3) Licensed Professional Engineer with three years of related experience.
  - b. Associate Special Inspector: Engineer-in-Training with one year experience of related experience.
- 8. Verification of Site Soil Condition, Fill Placement and Load-Bearing Requirements
  - a. Special Inspector:
    - 1) ICC Soils Special Inspector Certificate with one year of related experience, or
    - 2) NICET Soils Technician Level II Certificate in Construction Material Testing, or
    - 3) Geologist-In-Training with three years of related experience, or
    - 4) Licensed Professional Engineer with three years of related experience.
  - b. Associate Special Inspector:
    - 1) NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or
    - 2) Engineer-In-Training with one year of related experience
- 9. Deep Foundations:
  - a. Special Inspector:
    - 1) NICET Soils Technician Level II Certificate in Construction Material Testing, or
    - 2) Geologist-In-Training with three years of related experience, or
    - 3) Licensed Professional Engineer with three years of related experience.
  - b. Associate Special Inspector:
    - 1) NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or
    - 2) NICET Geotechnical Engineering Technician Level I Construction or Generalist Certificate with one year of related experience, or
    - 3) Engineer-In-Training with one year of related experience.
- 10. Exterior Insulation and Finish System (EIFS):
  - a. Special Inspector:

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- 1) AWC EIFS Inspector Certificate, or
  - 2) Exterior Design Institute Certificate, or
  - 3) Licensed Professional Engineer or Architect with related experience.
- b. Associate Special Inspector: Engineer-In-Training with one year of related experience.
11. Special Inspector of Record (SIOR): Registered Professional Engineer with five years of related experience.

## PART 2 - PRODUCTS

### 2.1 FABRICATOR SPECIAL INSPECTIONS

- A. Special Inspections of fabricator's work performed in the fabricator's shop is required to be inspected in accordance with the Schedule of Special Inspections unless the fabricator is certified by the approved agency to perform such work without Special Inspections. Submit the following certification [certifications] to the Owner for information to allow work performed in the fabricator's shop to not be subjected to Special Inspections.

AISC Certified Steel Fabricator.

Truss Plate Institute (TPI) steel truss plant quality assurance program certification.

Truss Plate Institute (TPI) wood truss plant quality assurance program certification.

International Accreditation Service, AC472 Accreditation

Steel Joist Institute Membership

Precast Concrete Institute (PCI) Certified Plant, Group C

At the completion of fabrication, submit a certificate of compliance, to be included with the comprehensive final report of Special Inspections, stating that the materials supplied and work performed by the fabricator are in accordance with the construction documents.

## PART 3 - EXECUTION

### 3.1 RESPONSIBILITIES

- A. Special Inspector of Record:
1. Supervise all Special Inspectors required by the Contract Documents and the IBC.
  2. Submit a SIOR Letter of Acceptance to the Owner attesting to acceptance of the duties of SIOR, signed and sealed by the SIOR.
  3. Verify the qualifications of all of the Special Inspectors.
  4. Verify the qualifications of fabricators.
  5. Submit Special Inspections agency's written NDT practices for the monitoring and control of the agency's operations to include the following:
    - a. The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel.

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- b. The agency's inspection procedures, including general inspection, material controls, and visual welding inspection.
- 6. Submit qualification records for nondestructive testing (NDT) technicians designated for the project.
- 7. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.
- 8. Prepare a Special Inspections Project Manual, which must cover the following:
  - a. Roles and responsibilities of the following individuals during Special Inspections: SIOR, SI, ASI, General Contractor's QC Manager and SER.
  - b. Organizational chart or communication plan, indicating lines of communication.
  - c. Contractor's internal plan for scheduling inspections. Address items such as timeliness of inspection requests, who to contact for inspection requests, and availability of alternate inspectors.
  - d. Propose forms or templates to be used by SI and SIOR to document inspections.
  - e. Indicate procedures for tracking nonconforming work and verification that corrective work is complete.
  - f. Indicate how the SIOR and SI will participate in weekly QC meetings.
  - g. Indicate how Special Inspections of shop fabricated items will be handled when the fabricator's shop is not certified in accordance with paragraph FABRICATOR SPECIAL INSPECTIONS.
  - h. Include a section in the manual that covers each specific item requiring Special Inspections that is indicated on the Schedule of Special Inspections. Provide names and qualifications of each special inspector who will be performing the Special Inspections for each specific item. Provide detail on how the Special Inspections are to be carried out for each item so that the expectations are clear for the General Contractor and the Subcontractor performing the work.

Make a copy of the Special Inspections Project Manual available on the job site during construction. Submit a copy of the Special Inspections Project Manual for approval.

- 9. Attend coordination and mutual understanding meeting where the information in the Special Inspections Project Manual will be reviewed to verify that all parties have a clear understanding of the Special Inspections provisions and the individual duties and responsibilities of each party.
- 10. Maintain a 3-ring binder for the Special Inspector's daily and biweekly reports and the Special Inspections Project Manual. This file must be located in a conspicuous place in the project trailer/office to allow review by the Owner and the SER.
- 11. Submit a copy of the Special Inspector's daily reports to the QC Manager.
- 12. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.
- 13. Submit a biweekly Special Inspections report until all work requiring Special Inspections is complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following:
  - a. A brief summary of the work performed during the reporting time frame.
  - b. Changes and discrepancies with the drawings, specifications that were observed during the reporting period.

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- c. Discrepancies which were resolved or corrected.
- d. A list of nonconforming items requiring resolution.
- e. All applicable test results including nondestructive testing reports.

B. Special Inspectors:

1. Inspect all elements of the project for which the special inspector is qualified to inspect and are identified in the Schedule of Special Inspections.
2. Attend preparatory phase meetings related to the Definable Feature of Work (DFOW) for which the special inspector is qualified to inspect.
3. Submit Special Inspections agency's written NDT practices for the monitoring and control of the agency's operations to include the following:
  - a. The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel.
  - b. The agency's inspection procedures, including general inspection, material controls, and visual welding inspection.
4. Submit qualification records for nondestructive testing (NDT) technicians designated for the project.
5. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.
6. Submit a copy of the daily reports to the QC Manager.
7. Report discrepancies that are observed during Special Inspections to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.
8. Submit a biweekly Special Inspection Report until all inspections are complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following:
  - a. A brief summary of the work performed during the reporting time frame.
  - b. Changes and discrepancies with the drawings, specifications and mechanical or electrical component certification that were observed during the reporting period.
  - c. Discrepancies which were resolved or corrected.
  - d. A list of nonconforming items requiring resolution.
  - e. All applicable test results including nondestructive testing reports.

3.2 DETECTIVE WORK

- A. Check work as it progresses, but failure to detect any defective work or materials must in no way prevent later rejection if defective work or materials are discovered, nor obligate the Owner to accept such work.

END OF SECTION



## SCHEDULE OF SPECIAL INSPECTIONS

Reference UFGS 01 45 35 for all requirements not noted as part of this schedule.

### **INSPECTION DEFINITIONS:**

- PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and noted verification.
- OBSERVE:** Observe these items randomly during the course of each work day to insure that applicable requirements are being met. Operations need not be delayed pending these inspections at contractor's risk.
- DOCUMENT:** Document, with a report, that the work has been performed in accordance with the contract documents. This is in addition to any other reports required in the Special Inspections guide specification.
- CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

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The Seismic Design Category for this project is: ☐ A, ☒ B, ☐ C, ☐ D, ☐ E, ☐ F (check appropriate box)

**STRUCTURAL - STEEL – WELDING SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

STEEL INSPECTION <u>PRIOR TO WELDING</u> – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-1		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Verify that the welding procedures specification (WPS) is available	<b>PERFORM</b>	
2. Verify manufacturer certifications for welding consumables are available	<b>PERFORM</b>	
3. Verify material identification	<b>PERFORM</b>	Type and grade.
4. Welder Identification System	<b>PERFORM</b>	The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.
5. Fit-up of groove welds (including joint geometry)	OBSERVE	<ul style="list-style-type: none"> <li>✓ Joint preparation</li> <li>✓ Dimensions (alignment, root opening, root face, bevel)</li> <li>✓ Cleanliness (condition of steel surfaces)</li> <li>✓ Tacking (tack weld quality and location)</li> <li>✓ Backing type and fit (if applicable)</li> </ul>
6. Configuration and finish of access holes	OBSERVE	
7. Fit-up of fillet welds	OBSERVE	<ul style="list-style-type: none"> <li>✓ Dimensions (alignment, gaps at root)</li> <li>✓ Cleanliness (condition of steel surfaces)</li> <li>✓ Tacking (tack weld quality and location)</li> </ul>
STEEL INSPECTION <u>DURING WELDING</u> – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-2		
TASK	INSPECTION TYPE	DESCRIPTION
8. Use of qualified welders	<b>PERFORM</b>	Welding by welders, welding operators, and tack welders who are qualified in conformance with requirements.
9. Control and handling of welding consumables	OBSERVE	<ul style="list-style-type: none"> <li>✓ Packaging</li> <li>✓ Electrode atmospheric exposure control</li> </ul>
10. No welding over cracked tack welds	OBSERVE	
11. Environmental conditions	OBSERVE	<ul style="list-style-type: none"> <li>✓ Wind speed within limits</li> <li>✓ Precipitation and temperature</li> </ul>
12. Welding Procedures Specification followed	OBSERVE	<ul style="list-style-type: none"> <li>✓ Settings on welding equipment</li> <li>✓ Travel speed</li> <li>✓ Selected welding materials</li> <li>✓ Shielding gas type/flow rate</li> <li>✓ Preheat applied</li> <li>✓ Interpass temperature maintained (min./max.)</li> <li>✓ Proper position (F, V, H, OH)</li> <li>✓ Intermix of filler metals avoided</li> </ul>
13. Welding techniques	OBSERVE	<ul style="list-style-type: none"> <li>✓ Interpass and final cleaning</li> <li>✓ Each pass within profile limitations</li> <li>✓ Each pass meets quality requirements</li> </ul>

<sup>1</sup> **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

**OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

**STRUCTURAL - STEEL – WELDING SECTION (CONTINUED)**

STEEL INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-3		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
14. Welds cleaned	OBSERVE	
15. Size, length, and location of all welds	PERFORM	Size, length, and location of all welds conform to the requirements of the detail drawings.
16. Welds meet visual acceptance criteria	PERFORM AND DOCUMENT	<ul style="list-style-type: none"> <li>✓ Crack prohibition</li> <li>✓ Weld/base-metal fusion</li> <li>✓ Crater cross section</li> <li>✓ Weld profiles</li> <li>✓ Weld size</li> <li>✓ Undercut</li> <li>✓ Porosity</li> </ul>
17. Arc strikes	PERFORM	
18. k-area	PERFORM	When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks.
19. Backing removed, weld tabs removed and finished, and fillet welds added where required	PERFORM	
20. Repair activities	PERFORM AND DOCUMENT	
21. Document acceptance or rejection of welded joint or member	PERFORM	

**END SECTION**

<sup>1</sup> **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.

**STRUCTURAL - STEEL – BOLTING SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

STEEL INSPECTION TASKS PRIOR TO BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-1		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Manufacture's certifications available for fastener materials	<b>PERFORM</b>	
2. Fasteners marked in accordance with ASTM requirements	OBSERVE	
3. Proper fasteners selected for joint detail (grade, type, bolt length if threads are to be excluded from shear plane)	OBSERVE	
4. Proper bolting procedure selected for joint detail	OBSERVE	
5. Connecting elements, including appropriate faying surface condition and hole preparation, if specified, meet applicable requirements	OBSERVE	
6. Proper storage provided for bolts, nuts, washers, and other fastener components	OBSERVE	
STEEL INSPECTION TASKS DURING BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-2		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
7. Fastener assemblies of suitable condition, placed in all holes and washers (if required) are positioned as required	OBSERVE	
8. Joint brought to the snug-tight condition prior to pretensioning operation	OBSERVE	
9. Fastener component not turned by the wrench prevented from rotating	OBSERVE	
10. Bolts are pretensioned in accordance with RCSC Specification, progressing systematically from the most rigid point toward the free edges	OBSERVE	
STEEL INSPECTION TASKS AFTER BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 360-10: Table C-N5.6-3		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
11. Document acceptance or rejection of all bolted connections	<b>DOCUMENT</b>	

**END SECTION**

<sup>1</sup> **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.  
**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.

**STRUCTURAL - STEEL - NON DESTRUCTIVE TESTING SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Section N5.5		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Use of qualified nondestructive testing personnel	<b>PERFORM</b>	Visual weld inspection and nondestructive testing (NDT) shall be conducted by personnel qualified in accordance with AWS D1.8 clause 7.2
2. Welded joints subject to fatigue	OBSERVE	Dye penetrant testing (DT) and Ultrasonic testing (UT) shall be performed on 100% of welded joints identified on contract drawings as being subject to fatigue.

**END SECTION**

<sup>1</sup> **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

**STRUCTURAL - STEEL – AISC 341 REQUIREMENTS (SEISMIC PROVISIONS) SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐**

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Section J6.2		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. CJP groove welds	OBSERVE	Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 100% of CJP groove welds for materials greater than 5/16" thick (8mm).
2. Beam cope and access hole.	OBSERVE	At welded splices and connections, thermally cut surfaces of beam copes and access holes shall be tested using magnetic particle testing (MT) or dye penetrant testing (DT), when the flange thickness exceeds 1 1/2 in. for rolled shapes, or when the web thickness exceeds 1 1/2 in. for built-up shapes.
3. K-area NDT (AISC 341)	PERFORM	Where welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, the web shall be tested for cracks using magnetic particle testing (MT). The MT inspection area shall include the k-area base metal within 3-inches of the weld. The MT shall be performed no sooner than 48 hours following completion of the welding.
4. Placement of reinforcing or contouring fillet welds	DOCUMENT	

**END SECTION**

<sup>1</sup> **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.  
**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.

**STRUCTURAL - STEEL - COMPOSITE CONSTRUCTION <sup>1</sup>****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

COMPOSITE CONSTRUCTION PRIOR TO PLACING CONCRETE – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table N6.1, AISC 341-16: Table J9.1		
TASK	INSPECTION TYPE <sup>2</sup>	DESCRIPTION
1. Placement and installation of steel headed stud anchors	<b>PERFORM</b>	
2. Material identification of reinforcing steel (Type/Grade)	OBSERVE	
3. Determination of carbon equivalent for reinforcing steel other than ASTM A706	OBSERVE	
4. Proper reinforcing steel size, spacing, clearances, support, and orientation	OBSERVE	
5. Reinforcing steel has not been re-bent in the field	OBSERVE	
6. Reinforcing clearances have been provided	OBSERVE	
7. Reinforcing steel has been tied and supported as required	OBSERVE	
8. Composite member has required size	OBSERVE	

**END SECTION****STRUCTURAL - STEEL - OTHER INSPECTIONS****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

OTHER STEEL INSPECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Tables J8.1 & J10.1		
TASK	INSPECTION TYPE <sup>2</sup>	DESCRIPTION
1. Anchor rods and other embedments supporting structural steel	<b>PERFORM</b>	Verify the diameter, grade, type, and length of the anchor rod or embedded item, and the extent or depth of embedment prior to placement of concrete.
2. Fabricated steel or erected steel frame	OBSERVE	Verify compliance with the details shown on the construction documents, such as braces, stiffeners, member locations and proper application of joint details at each connection.
3. Reduced beam sections (RBS) where/if occurs	<b>DOCUMENT</b>	✓ Contour and finish ✓ Dimensional tolerances
4. Protected zones	<b>DOCUMENT</b>	No holes or unapproved attachments made by fabricator or erector
5. H-piles where/if occurs	<b>DOCUMENT</b>	No holes or unapproved attachments made by the responsible contractor

**END SECTION**<sup>1</sup> See Concrete Construction Section for all concrete related inspection of composite steel construction.

<sup>2</sup> **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.  
**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.

**STRUCTURAL - COLD-FORMED METAL DECK - PLACEMENT SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

METAL DECK INSPECTION <u>PRIOR TO</u> DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.1		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness	<b>PERFORM</b>	
2. Document acceptance or rejection of deck and deck accessories	<b>DOCUMENT</b>	
METAL DECK INSPECTION <u>DURING</u> DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.2		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
3. Verify compliance of deck and all deck accessories installation with construction documents	<b>PERFORM</b>	
4. Verify deck materials are represented by the mill certifications that comply with the construction documents	<b>PERFORM</b>	
5. Document acceptance or rejection of installation of deck and deck accessories	<b>DOCUMENT</b>	
METAL DECK INSPECTION <u>AFTER</u> DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.3		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
6. Welding procedure specification (WPS) available	<b>PERFORM</b>	
7. Manufacturers certifications for welding consumables available	OBSERVE	
8. Material identification (type/grade)	OBSERVE	
9. Check welding equipment	OBSERVE	

**END SECTION**

<sup>1</sup> **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.  
**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.



**STRUCTURAL - COLD-FORMED METAL DECK – WELDING SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

METAL DECK INSPECTION <u>DURING</u> WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.4		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Use of qualified welders	OBSERVE	
2. Control and handling of welding consumables	OBSERVE	
3. Environmental conditions (wind speed, moisture, temperature)	OBSERVE	
4. WPS followed	OBSERVE	
METAL DECK INSPECTION <u>AFTER</u> WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.5		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
5. Verify size and location of welds, including support, sidelap, and perimeter welds.	<b>PERFORM</b>	
6. Welds meet visual acceptance criteria	<b>PERFORM</b>	
7. Verify repair activities	<b>PERFORM</b>	
8. Document acceptance or rejection of welds	<b>DOCUMENT</b>	

**END SECTION**

<sup>1</sup> **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.  
**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.

**STRUCTURAL - COLD-FORMED METAL DECK – FASTENING SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

METAL DECK INSPECTION <u>BEFORE</u> MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.6		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Manufacturer installation instructions available for mechanical fasteners	OBSERVE	
2. Proper tools available for fastener installation	OBSERVE	
METAL DECK INSPECTION <u>DURING</u> MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.7		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
3. Fasteners are positioned as required	OBSERVE	
4. Fasteners are installed in accordance with manufacturer's instructions	OBSERVE	
METAL DECK INSPECTION <u>AFTER</u> MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.8		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
5. Check spacing, type, and installation of support fasteners	<b>PERFORM</b>	
6. Check spacing, type, and installation of sidelap fasteners	<b>PERFORM</b>	
7. Check spacing, type, and installation of perimeter fasteners	<b>PERFORM</b>	
8. Verify repair activities	<b>PERFORM</b>	
9. Document acceptance or rejection of mechanical fasteners	<b>DOCUMENT</b>	

**END SECTION**

<sup>1</sup> **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.  
**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.

**STRUCTURAL - LIGHT GAUGE STEEL FRAMING AND/OR LIGHT GAUGE TRUSSES SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

LIGHT GAUGE STEEL CONSTRUCTION AND CONNECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.2, 1705.11.2, 1705.11.3, UFC 4 023 03		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Trusses spanning 60-feet or greater where/if applies	<b>PERFORM</b>	Verify that temporary and permanent truss restraint/bracing is installed in accordance with approved truss submittal package.
2. Welded connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all welds composing part of the main wind or seismic force resisting system, including shearwalls, braces, collectors (drag struts), and hold-downs.
3. Connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all screw attachment, bolting, anchoring and other fastening of components within the main wind or seismic force resisting system, including roof deck, roof framing, exterior wall covering, wall to roof/floor connections, braces, collectors (drag struts) and hold-downs.
4. Cold-formed steel (progressive collapse resisting system where/if applies)	OBSERVE	Verify proper welding operations, screw attachment, bolting, anchoring and other fastening of components within the progressive collapse resisting system, including horizontal tie force elements, vertical tie force elements and bridging elements (UFC 4 023 03).

**END SECTION****STRUCTURAL - OPEN-WEB STEEL JOISTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☒

OPEN-WEB STEEL JOISTS AND JOIST GIRDERS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.2.3		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Installation of open-web steel joists and joist girders	OBSERVE	✓ End connections – welded or bolted ✓ Bridging – horizontal and diagonal

**END SECTION**

<sup>1</sup> **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

**OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

**STRUCTURAL - CONCRETE CONSTRUCTION SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Inspect reinforcement, including prestressing tendons, and verify placement.	OBSERVE	Verify prior to placing concrete that reinforcing is of specified type, grade and size; that it is free of oil, dirt and unacceptable rust; that it is located and spaced properly; that hooks, bends, ties, stirrups and supplemental reinforcement are placed correctly; that lap lengths, stagger and offsets are provided; and that all mechanical connections are installed per the manufacturer's instructions and/or evaluation report.
2. Cast in place anchors and post installed drilled anchors (downward inclined)	OBSERVE	Verify prior to placing concrete that cast in place anchors and post installed drilled anchors have proper embedment, spacing and edge distance.
3. Post-installed adhesive anchors in horizontal or upward inclined orientations	<b>CONTINUOUS AND DOCUMENT</b>	<ul style="list-style-type: none"> <li>✓ Inspect as required per approved ICC-ES report</li> <li>✓ Verify that installer is certified for installation of horizontal and overhead installation applications</li> <li>✓ Inspect proof loading as required by the contract documents</li> </ul>
4. Verify use of required mix design	OBSERVE	Verify that all mixes used comply with the approved construction documents
5. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete	<b>CONTINUOUS</b>	At the time fresh concrete is sampled to fabricate specimens for strength test verify these tests are performed by qualified technicians.
6. Inspect concrete and/or shotcrete placement for proper application techniques	<b>CONTINUOUS</b>	Verify proper application techniques are used during concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.
7. Verify maintenance of specified curing temperature and technique	OBSERVE	Inspect curing, cold weather protection, and hot weather protection procedures.
8. Inspect formwork for shape, location and dimensions of the concrete member being formed.	OBSERVE	

**END SECTION**

<sup>1</sup> **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.

**CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

**STRUCTURAL - MASONRY CONSTRUCTION SECTION (ALL RISK CATEGORIES)****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE <u>AT START</u> OF CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Compliance with approved submittals prior to start	OBSERVE	
2. Proportions of site-mixed mortar.	OBSERVE	
3. Grade and type of reinforcement, anchor bolts, and prestressing tendons and anchorages	OBSERVE	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE <u>PRIOR TO</u> GROUTING IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
4. Grout space	OBSERVE	
5. Proportions of site-prepared grout and prestressing grout for bonded tendons	OBSERVE	
6. Proportions of site-mixed grout and prestressing grout for bonded tendons	OBSERVE	
7. Placement of masonry units and mortar joints	OBSERVE	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE <u>DURING</u> CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
8. Size and location of structural elements is in compliance	OBSERVE	
9. Preparation, construction, and protection of masonry during cold weather (temperature below 40°F (4.4°C) or hot weather (temp above 90°F (32.2°C))	OBSERVE	
10. Placement of grout and prestressing grout for bonded tendons	<b>CONTINUOUS</b>	
11. Observe preparation of grout specimens, mortar specimens, and/or prisms	OBSERVE	
12. Type, size and placement of reinforcement, connectors, and anchorages, including details of anchorage of masonry to structural members, frames, or other construction	OBSERVE	

**END SECTION**

<sup>1</sup> **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

**CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

**STRUCTURAL - WOOD CONSTRUCTION – SPECIALTY ITEMS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

WOOD CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.5		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. High-load diaphragms where applicable	OBSERVE	Verify thickness and grade of sheathing, size of framing members at panel edges, nail diameters and length, and the number of fastener lines and that fastener spacing is per approved contract documents.
2. Metal-plate connected wood trusses spanning 60 feet or greater	OBSERVE	Verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package

**END SECTION****STRUCTURAL - WOOD CONSTRUCTION - SEISMIC & WIND SECTION****THIS SECTION IS APPLICABLE IF BOX IS CHECKED:** ☐

WOOD CONSTRUCTION SEISMIC AND WIND – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.11 & 1705.12.2		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Nailing, bolting, anchoring and other fastening of elements of the main wind/seismic force-resisting system	OBSERVE (CONTINUOUS FOR GLUING)	Includes connectors for: shearwall sheathing, roof/floor sheathing, drag struts/collectors (double top plates), braces, hold downs, roof connections to exterior walls.

**END SECTION****STRUCTURAL – ISOLATION AND ENERGY DISSIPATION SYSTEMS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

ISOLATION AND ENERGY DISSIPATION SYSTEMS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC TABLE 1705.12.8		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Fabrication and installation	OBSERVE	Verify that fabrication and installation of isolator units and energy dissipation devices conform to manufacturer's recommendations and approved construction documents
2. Testing of seismic isolation Systems in seismically isolated structures		Seismic Isolation Systems in seismically isolated structures shall be tested accordance with ASCE 7, Section 17.8

**END SECTION**

<sup>1</sup> **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

**GEOTECHNICAL - SOILS INSPECTION SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

SOILS INSPECTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.6		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Materials below shallow foundations are adequate to achieve the design bearing capacity.	OBSERVE	
2. Excavations are extended to proper depth and have reached proper material	OBSERVE	
3. Perform classification and testing of compacted fill materials	<b>OBSERVE</b>	
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill	<b>CONTINUOUS</b>	
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	OBSERVE	During fill placement, the special inspector shall verify that proper materials and procedures are used in accordance with the provisions of the approved geotechnical report

**END SECTION****GEOTECHNICAL - DRIVEN DEEP FOUNDATION ELEMENTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐**

DEEP DRIVEN FOUNDATION CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.7		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Verify element materials, sizes and lengths comply with requirements	<b>CONTINUOUS</b>	
2. Inspect driving operations and maintain complete and accurate records for each element	<b>CONTINUOUS</b>	
3. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element	<b>CONTINUOUS</b>	
4. Determine capacities of test elements and conduct additional load tests if required.	<b>CONTINUOUS</b>	
5. For steel or concrete elements, perform additional special inspections in accordance with the Steel and Concrete sections in this schedule		

**END SECTION**

<sup>1</sup> **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

**CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

**GEOTECHNICAL - MICRO PILE FOUNDATIONS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☒

MICRO PILE FOUNDATIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.9		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Record installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data as required. The approved geotechnical report and the contract documents shall be used to determine compliance	<b>CONTINUOUS</b>	

**END SECTION****GEOTECHNICAL - CAST IN PLACE DEEP FOUNDATION ELEMENTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

CAST IN PLACE DEEP FOUNDATION ELEMENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.8		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Inspect drilling operations and maintain complete and accurate records for each element.	<b>CONTINUOUS</b>	
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes	<b>CONTINUOUS</b>	For concrete elements, perform additional special inspections in accordance with the Concrete section in this schedule

**END SECTION**

<sup>1</sup> **CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.



**FIRE PROTECTION - SPRAYED FIRE-RESISTANT MATERIALS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

SPRAYED FIRE RESISTANT MATERIALS (SFRM) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.14		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Substrate condition	OBSERVE	Prior to application, confirm that surfaces have been prepared according to the approved fire-resistance design and manufacturer's instructions.
2. Material thickness	OBSERVE	Verify SFRM thickness according to 2018 IBC 1705.14.4
3. Material density	OBSERVE	Verify SFRM density according to 2018 IBC 1705.14.5
4. Bond strength	OBSERVE	Verify bond strength of cured SFRM according to IBC 1705.14.6

**END SECTION****FIRE PROTECTION - MASTIC AND INTUMESCENT COATINGS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.15		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Inspect according to AWCI 12-B and the contract documents	OBSERVE	Inspections shall be performed in accordance with AWCI 12-B, Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials.

**END SECTION****FIRE PROTECTION – FIRE RESISTANT PENETRATIONS AND JOINTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

FIRE RESISTANT PENETRATIONS AND JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.17		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Inspections of penetration firestop systems conducted in accordance with ASTM E 2174.	OBSERVE	
2. Inspections of fire-resistant joint systems conducted in accordance with ASTM E 2393	OBSERVE	

**END SECTION**

<sup>1</sup> **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

**FIRE PROTECTION – SMOKE CONTROL SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐**SMOKE CONTROL – VERIFY THE FOLLOWING ARE IN COMPLIANCE**  
2018 IBC 1705.18

TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Verify device locations and perform leakage testing	OBSERVE	Perform during erection of ductwork and prior to concealment
2. Pressure difference testing, flow measurements and detection and control verification	OBSERVE	Perform prior to occupancy and after sufficient completion

**END SECTION**

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<sup>1</sup> **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

**ARCHITECTURAL - EXTERIOR INSULATION AND FINISH SYSTEMS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.16		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Water resistive barrier coating applied over a sheathing substrate.	OBSERVE	Verify that water resistive barrier coating complies with ASTM E 2570.

**END SECTION****ARCHITECTURAL – ARCHITECTURAL COMPONENTS****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

ARCHITECTURAL COMPONENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.12.5, 1705.12.7		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Erection and fastening of exterior cladding and interior and exterior veneer.	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. <b>Inspector Note: Inspection not required if height is less than 30 feet or weight is less than 5psf</b>
2. Interior and exterior non-load bearing walls	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. <b>Inspector Note: Inspection not required if interior non-load bearing walls weigh less than 15psf</b>
3. Access floors	OBSERVE	Verify that anchorage complies with approved construction documents.
4. Storage racks	OBSERVE	Verify that anchorage complies with approved construction documents. Inspection of post-installed anchors shall comply with approved ICC-ES report. <b>Inspector Note: Not required for racks less than 8 feet in height</b>

**END SECTION**

<sup>1</sup> **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

## PLUMBING/MECHANICAL/ELECTRICAL DESIGNATED SEISMIC SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

PLUMBING, MECHANICAL AND ELECTRICAL IBC 1705.12.6		
TASK	INSPECTION TYPE <sup>1</sup>	DESCRIPTION
1. Anchorage of electrical equipment for emergency and standby power systems	OBSERVE	✓ Check for general conformance
2. Anchorage of all other electrical equipment in Seismic Design Categories E and F only (See first page of this schedule for Seismic Design Category)	OBSERVE	✓ Check for general conformance
3. Installation and anchorage of piping designed to carry hazardous materials and their associated mechanical units.	OBSERVE	✓ Check for general conformance
4. Installation and anchorage of vibration isolation systems where the construction documents require a nominal clearance of ¼" or less between support framing and restraint.	OBSERVE	✓ Check for general conformance
5. Verification of clearance between fire sprinkler piping and surrounding mechanical and electrical equipment, including ductwork, piping and their structural supports.	OBSERVE	✓ Check for minimum clearances noted in ASCE7 13.2.3 or a nominal clearance of not less than 3 inches

END SECTION

<sup>1</sup> **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's Representative, Architect, construction forces, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- C. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- C. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

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- D. Implementation and Termination Schedule: Within 10 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- E. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- F. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- G. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- H. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.
- I. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
  - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
  - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
  - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- J. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
  - 1. Locations of dust-control partitions at each phase of work.
  - 2. HVAC system isolation schematic drawing.
  - 3. Location of proposed air-filtration system discharge.
  - 4. Waste-handling procedures.
  - 5. Other dust-control measures.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines.

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1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.
- B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- C. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats minimum 36 by 60 inches.
- D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

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2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.



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- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
  - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
  - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
    - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
    - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
  - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
  - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  - 1. Install temporary electric power service underground or above ground.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install two land based telephone lines for each field office.
  - 1. Provide one telephone line for Owner's use.
  - 2. At each telephone, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Contractor's emergency after-hours telephone number.
    - e. Architect's office.
    - f. Owner's representative's office.
    - g. Engineers' offices.
    - h. Owner's office.

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- i. Principal subcontractors' field and home offices.
- J. Electronic Communication Service: Provide temporary internet service in common-use facilities available to Owner, Architect, and Clerk-of-the-Works.
  - 1. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 3 Mbps upload and 15 Mbps download speeds at each computer.

3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
  - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Use of Planned Permanent Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
  - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
  - 2. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
  - 3. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
  - 4. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel. Coordinate location of temporary parking area with Owner and Architect. Within limits of construction area. Existing parking facilities are not available or permitted for contractor use.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  - 2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

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1. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  2. Maintain and touch up signs so they are legible at all times.
- G. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- J. Temporary Elevator Use: Use of elevators is not permitted.
- K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing."
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

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- E. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- G. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations and as indicated on Drawings.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
  - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

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3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
  - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
  - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
  - 3. Indicate methods to be used to avoid trapping water in finished work.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  - 1. Protect porous materials from water damage.
  - 2. Protect stored and installed material from flowing or standing water.
  - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
  - 4. Remove standing water from decks.
  - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  - 2. Keep interior spaces reasonably clean and protected from water damage.
  - 3. Periodically collect and remove waste containing cellulose or other organic matter.
  - 4. Discard or replace water-damaged material.
  - 5. Do not install material that is wet.
  - 6. Discard and replace stored or installed material that begins to grow mold.
  - 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
  - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
  - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 24 hours are considered defective and require replacing.
    - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.

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- c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION

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SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of this Section Includes: General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Requirements:
  - 1. Section 015000 "Temporary Facilities and Controls" for temporary controls, utilities, support facilities, temporary site fencing, and, if applicable, temporary erosion and sedimentation controls if not specified in Section 311000 "Site Clearing".
  - 2. Section 311000 "Site Clearing" for removing existing trees and shrubs and for temporary erosion- and sedimentation-control measures if not specified in Section 015000 "Temporary Facilities and Controls".

1.2 DEFINITIONS

- A. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape at a height 54 inches above the ground line for trees with caliper of 8 inches or greater as measured at a height of 12 inches above the ground.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- C. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
    - a. Tree-service firm's personnel and equipment needed to make progress and avoid delays.
    - b. Arborist's responsibilities.
    - c. Quality-control program.
    - d. Coordination of Work and equipment movement with the locations of protection zones.
    - e. Trenching by hand or with air spade within protection zones.
    - f. Field quality control.

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1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data:
  - 1. General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction
- C. Shop Drawings:
  - 1. Include plans, elevations, and sections showing trees and plants to be protected, locations of protection-zone fencing and signage, and the relationship between equipment-movement routes and material storage locations with protection zones.
  - 2. Detail fabrication and assembly of protection-zone fencing and signage.
  - 3. Indicate extent of utility boring and trenching by hand or with air spade within protection zones.
- D. Tree-Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
  - 1. Species and size of tree.
  - 2. Location on site plan. Include unique identifier for each.
  - 3. Reason for pruning.
  - 4. Description of pruning to be performed.
  - 5. Description of maintenance following pruning.
- E. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Statements: For arborist and tree service firm.
- C. Certification: From arborist, certifying that trees indicated to remain have been protected during construction in accordance with recognized standards and that trees were promptly and properly treated and repaired when damaged.
- D. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- E. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
  - 1. Use sufficiently detailed photographs or video recordings.



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2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

F. Quality-control program.

1.6 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA and licensed arborist in jurisdiction where Project is located.
- B. Tree-Service Firm Qualifications: An experienced tree-service firm that has successfully completed temporary tree- and plant-protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection-zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.7 FIELD CONDITIONS

- A. The following practices are prohibited within protection zones:
  1. Storage of construction materials, debris, or excavated material.
  2. Moving or parking vehicles or equipment.
  3. Foot traffic.
  4. Erection of sheds or structures.
  5. Impoundment of water.
  6. Excavation or other digging unless otherwise indicated.
  7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.
- D. Take precautions to protect plants from airborne contaminants, such as paint or fireproofing overspray.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Backfill Soil: Stockpiled soil mixed with planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of

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coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

1. Mixture: Well-blended mix of 2 parts stockpiled soil to 1 part planting soil.
  2. Planting Soil: Planting soil as specified in Section 329115 "Soil Preparation (Performance Specification)."
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
1. Type: Shredded hardwood.
  2. Size Range: 3 inches maximum, 1/2 inch minimum.
  3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements: Previously used materials may be used when approved by Architect.
1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi; secured with plastic bands or galvanized-steel or stainless steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart.
    - a. Height: 48 inches.
    - b. Color: High-visibility orange, nonfading.
  2. Gates: Single-swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches. Alternatively, a 36-inch opening can be provided in lieu of a gate.
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
1. Size and Text: 12 inches by 18 inches, "Attention: Tree Protection Zone, No Access or Storage Allowed".
  2. Lettering: 3-inch-high minimum, red characters on white background.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

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3.2 PREPARATION

- A. Locate and clearly identify groups of trees, shrubs, and other vegetation to remain.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.3 PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
  - 1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
  - 2. Access Gates: Install and adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
  - 3. Plastic Fencing: Stretch fabric taut and secure to posts without bows or sags.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 100 ft. on protection-zone fencing, but no fewer than two signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Maintain hydration of plants to assure plant survival.
- E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
  - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
  - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones in accordance with requirements in Section 312000 "Earth Moving" unless otherwise indicated.

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- B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

### 3.5 ROOT PRUNING

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots and as follows:
  - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
  - 2. Cut Ends: Do not paint cut root ends.
  - 3. Temporarily support and protect roots from damage until they are permanently covered with soil.
  - 4. Cover exposed roots with burlap and water regularly.
  - 5. Backfill as soon as possible in accordance with requirements in Section 312000 "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune tree roots flush with the edge of the protection zone by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

### 3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.
  - 1. Prune to remove only broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
  - 2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
  - 3. Pruning Standards: Prune trees in accordance with ANSI A300 (Part 1).
- B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.
- C. Cut branches with sharp pruning instruments; do not break or chop.
- D. Do not paint or apply sealants to wounds.
- E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.
- F. Chip removed branches and dispose of off-site.

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3.7 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
  - 1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR

- A. General: Repair trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
  - 1. Submit details of proposed pruning and repairs.
  - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours in accordance with arborist's written instructions.
- B. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 ft. beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch-diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

END OF SECTION

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 014200 "References" for applicable industry standards for products.
  - 2. Section 017700 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
  - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
  - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight,

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dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
  - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
  - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
  - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.

1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

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1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
  - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
  - 2. Store products to allow for inspection and measurement of quantity or counting of units.
  - 3. Store materials in a manner that will not endanger Project structure.
  - 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
  - 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.



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1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
    - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
  2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

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3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
    - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
  4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
    - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
  5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
    - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
  6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
    - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
  7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

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2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
  2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Progress cleaning.
  - 6. Protection of installed construction.
  - 7. Correction of the Work.
- B. Related Requirements:
  - 1. Section 011000 “Summary” for limits on use of Project site.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
  - 1. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

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1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
    - a. Water, moisture, or vapor barriers.
    - b. Membranes and flashings.
    - c. Exterior curtain-wall construction.
    - d. Sprayed fire-resistive material.
    - e. Equipment supports.
    - f. Piping, ductwork, vessels, and equipment.
  4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

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3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

3.4 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.5 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as



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practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.6 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

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1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

3.8 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

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- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

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SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.

END OF SECTION

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
  - 5. Repair of the Work.
- B. Related Requirements:
  - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
  - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of cleaning agent.
- C. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- D. Certified List of Incomplete Items: Final submittal at final completion.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Certificates of Release: From authorities having jurisdiction.
- C. Certificate of Insurance: For continuing coverage.
- D. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
  - 5. Submit testing, adjusting, and balancing records.
  - 6. Submit sustainable design submittals not previously submitted.
  - 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

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1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
  6. Advise Owner of changeover in utility services.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
  5. Submit final completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.



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1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
  1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.
  4. Submit list of incomplete items in one of the following formats:
    - a. MS Excel electronic file. Architect will return annotated file.
    - b. Web-based project software upload. Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  1. Submit on digital media acceptable to Architect.
- E. Warranties in Paper Form:

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1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural

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- weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - h. Sweep concrete floors broom clean in unoccupied spaces.
  - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
  - 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
  - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
  - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
- 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.

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- a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory manuals.
  - 2. Emergency manuals.
  - 3. Systems and equipment operation manuals.
  - 4. Systems and equipment maintenance manuals.
  - 5. Product maintenance manuals.
- B. Related Requirements:
  - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
  - 2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.

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2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- C. Format: Submit operation and maintenance manuals in the following format:
  1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
  2. Submit three paper copies. Architect will return two copies.
- D. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- E. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
  1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- F. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
  1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

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- b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
  - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
  - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  1. Title page.
  2. Table of contents.
  3. Manual contents.
- B. Title Page: Include the following information:
  1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name and contact information for Contractor.
  6. Name and contact information for Construction Manager.
  7. Name and contact information for Architect.
  8. Name and contact information for Commissioning Authority.
  9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

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1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
  1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
  2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
  3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
  1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.
  6. Water outage.
  7. System, subsystem, or equipment failure.
  8. Chemical release or spill.



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- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
  - 1. Instructions on stopping.
  - 2. Shutdown instructions for each type of emergency.
  - 3. Operating instructions for conditions outside normal operating limits.
  - 4. Required sequences for electric or electronic systems.
  - 5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  - 2. Performance and design criteria if Contractor has delegated design responsibility.
  - 3. Operating standards.
  - 4. Operating procedures.
  - 5. Operating logs.
  - 6. Wiring diagrams.
  - 7. Control diagrams.
  - 8. Piped system diagrams.
  - 9. Precautions against improper use.
  - 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
  - 1. Product name and model number. Use designations for products indicated on Contract Documents.
  - 2. Manufacturer's name.
  - 3. Equipment identification with serial number of each component.
  - 4. Equipment function.
  - 5. Operating characteristics.
  - 6. Limiting conditions.
  - 7. Performance curves.
  - 8. Engineering data and tests.
  - 9. Complete nomenclature and number of replacement parts.

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- D. Operating Procedures: Include the following, as applicable:
  - 1. Startup procedures.
  - 2. Equipment or system break-in procedures.
  - 3. Routine and normal operating instructions.
  - 4. Regulation and control procedures.
  - 5. Instructions on stopping.
  - 6. Normal shutdown instructions.
  - 7. Seasonal and weekend operating instructions.
  - 8. Required sequences for electric or electronic systems.
  - 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

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- a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
  - E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
    1. Test and inspection instructions.
    2. Troubleshooting guide.
    3. Precautions against improper maintenance.
    4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    5. Aligning, adjusting, and checking instructions.
    6. Demonstration and training video recording, if available.
  - F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
    1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
    2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
  - G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
  - H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
  - I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
    1. Include procedures to follow and required notifications for warranty claims.
  - J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
    1. Do not use original project record documents as part of maintenance manuals.
- 1.11 PRODUCT MAINTENANCE MANUALS
- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

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- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 017300 "Execution" for final property survey.
  - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
  - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set of marked-up record prints.
  - 2. Number of Copies: Submit copies of record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit one paper-copy set of marked-up record prints.
      - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
      - 2) Print each drawing, whether or not changes and additional information were recorded.

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- C. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- D. Record Product Data: Submit one paper copy and annotated PDF electronic files and directories of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- E. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  - 2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

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4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
  4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
    - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file with comment function enabled.
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

## 1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
  3. Note related Change Orders, record Product Data, and record Drawings where applicable.

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- B. Format: Submit record Specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- C. Format: Submit record Product Data as annotated PDF electronic file.
  - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
  - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.



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PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
  - 2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- C. Qualification Data: For facilitator, instructor, and videographer.
- D. Attendance Record: For each training module, submit list of participants and length of instruction time.
- E. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

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1. Identification: On each copy, provide an applied label with the following information:
  - a. Name of Project.
  - b. Name and address of videographer.
  - c. Name of Architect.
  - d. Name of Construction Manager.
  - e. Name of Contractor.
  - f. Date of video recording.
2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

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- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Systems and equipment operation manuals.
    - c. Systems and equipment maintenance manuals.
    - d. Product maintenance manuals.
    - e. Project Record Documents.
    - f. Identification systems.
    - g. Warranties and bonds.
    - h. Maintenance service agreements and similar continuing commitments.
  3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.
  4. Operations: Include the following, as applicable:
    - a. Startup procedures.
    - b. Equipment or system break-in procedures.
    - c. Routine and normal operating instructions.
    - d. Regulation and control procedures.
    - e. Control sequences.
    - f. Safety procedures.
    - g. Instructions on stopping.
    - h. Normal shutdown instructions.
    - i. Operating procedures for emergencies.
    - j. Operating procedures for system, subsystem, or equipment failure.
    - k. Seasonal and weekend operating instructions.
    - l. Required sequences for electric or electronic systems.
    - m. Special operating instructions and procedures.

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5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.

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2. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with Owner with at least fourteen days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD modewith vibration reduction technology.
  1. Submit video recordings on CD-ROM or thumb drive and by uploading to web-based Project software site.
  2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
  3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
  4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
    - a. Name of Contractor/Installer.
    - b. Business address.
    - c. Business phone number.
    - d. Point of contact.
    - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

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1. Film training session(s) in segments not to exceed 15 minutes.
  - a. Produce segments to present a single significant piece of equipment per segment.
  - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
  - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
  1. Furnish additional portable lighting as required.
- E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION

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SECTION 018113.20 - SUSTAINABLE DESIGN REQUIREMENTS - LEED v4.1 BD+C: NEW  
CONSTRUCTION AND MAJOR RENOVATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements and procedures for compliance with USGBC's LEED prerequisites and credits needed for Project to obtain LEED Silver certification based on USGBC's "LEED v4.1 for Building Design and Construction" (hereafter, LEED v4.1 BD+C).
  - 1. Specific requirements for LEED are also included in other Sections.
  - 2. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
  - 3. A copy of LEED Project checklist is attached at end of this Section for information only.
    - a. Some LEED prerequisites and credits needed to obtain indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.

1.2 DEFINITIONS

- A. ANSI/BIFMA e3 Furniture Sustainability Standard: Standard addressing environmental and social impacts throughout the furniture supply chain.
- B. Bio-Based Materials: Products containing some percentage of biologically renewable resource.
- C. BUG Rating Method: The BUG rating of a fixture determines how much light trespass is produced by considering backlight (B), uplight (U), and glare (G).
- D. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001. Certificates to include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- E. Cradle to Cradle: Product certification assessing material health, material reutilization, renewable energy and carbon management, water stewardship, and social fairness.
- F. Declare: A product transparency disclosure that identifies material source, composition, and end-of-life procedures.
- G. Environmental Product Declaration (EPD): A transparency reporting tool communicating what a product is made of and the environmental impact.
- H. Extended Producer Responsibility: A waste management strategy promoting integration of life-



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cycle costs associated with goods into the market price of products. Typically, this involves a take-back or recycling program run by manufacturer at the end of the product's lifespan.

- I. Facts: Standard evaluating sustainability of furniture products over the product life cycle.
- J. Health Product Declaration (HPD): Disclosure of products contents and associated health information.
- K. LEED: USGBC's "LEED v4.1 for Building Design and Construction." Definitions that are part of this document apply to this Section.
- L. Living Product Challenge: A product framework for manufacturers examining place, water, energy, health, materials, and equity in production of materials.
- M. Manufacturer Inventory: A published, complete content inventory for products.
- N. Product Lens: Transparency disclosure highlighting hazard information.
- O. REACH Optimization: International standard outlining hazardous substances of high concern to be avoided in material composition.
- P. Recycled Content: The recycled content value of a material assembly to be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
  - 1. "Postconsumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
  - 2. "Preconsumer" material is defined as material diverted from the waste stream during the manufacturing process. Reutilization of materials (such as rework, regrind, or scrap, generated in a process and capable of being reclaimed within the same process that generated it) is excluded.
- Q. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) contributes to the regional value.
- R. WaterSense Label: The WaterSense label from the EPA specifies water efficiency and performance.
- S. Whole-Building Life-Cycle Assessment: The Life Cycle Assessment (LCA) is a methodology that evaluates the carbon and other environmental impacts of building materials over the projected lifespan of the building.

### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site. Review sustainability goals, municipal and state sustainability requirements, LEED objectives, and action plans for meeting requirements.

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1.4 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect about USGBC's LEED prerequisites and credits that are Contractor's responsibility, that depend on product selection or product qualities, or that depend on Contractor's procedures until USGBC has made its determination on Project's LEED certification application.
- B. Submit documentation to USGBC and respond to questions and requests from USGBC about its LEED prerequisites and credits that are Contractor's responsibility, that depend on product selection or product qualities, or that depend on Contractor's procedures until USGBC has made its determination on Project's LEED certification application.
  - 1. Document correspondence with USGBC as informational submittals.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. General: Submit sustainable design submittals required by other Sections.
- C. Sustainable design submittals are in addition to other submittals.
  - 1. If submitted item is identical to that submitted to comply with other requirements, include additional copy with other submittal as a record of compliance with indicated LEED requirements instead of separate sustainable design submittal. Mark additional copy "Sustainable design submittal."
- D. Sustainable Design Documentation Submittals:
  - 1. Plumbing submittal packages.
  - 2. Mechanical submittal packages.
  - 3. EPDs complying with LEED requirements.
  - 4. Documentation for products that comply with LEED requirements for multi-attribute optimization.
  - 5. Sustainability reports for products that comply with LEED requirements for sourcing of raw materials.
  - 6. Material ingredient reports for products that comply with LEED requirements for material ingredient reporting.
  - 7. Documentation for products that comply with LEED requirements for material ingredient optimization.
  - 8. Documentation complying with Section 017419 "Construction Waste Management and Disposal."
  - 9. Product data for adhesives and sealants used inside the weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.
  - 10. Product data for paints and coatings used inside the weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.
  - 11. Laboratory test reports for flooring, indicating compliance with requirements for low-

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- emitting materials.
- 12. Laboratory test reports for wall materials, indicating compliance with requirements for low-emitting materials.
- 13. Laboratory test reports for ceilings, indicating compliance with requirements for low-emitting materials.
- 14. Laboratory test reports for insulation, indicating compliance with requirements for low-emitting materials.
- 15. Laboratory test reports for furniture, indicating compliance with requirements for low-emitting materials.
- 16. Laboratory test reports for products containing composite wood or agrifiber products or wood glues, indicating compliance with requirements for low-emitting materials.
- 17. Construction Indoor Air Quality (IAQ) Management:
  - a. Construction IAQ management plan.
  - b. Product data for temporary filtration media.
  - c. Product data for filtration media used during occupancy.
  - d. Construction Documentation: Six photographs at three different times during construction period, along with a brief description of SMACNA approach employed, documenting implementation of IAQ management measures, including protection of ducts and on-site stored or installed absorptive materials.
- 18. IAQ Assessment:
  - a. Signed statement describing the building air flush-out procedures, including dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
  - b. Product data for filtration media used during flush-out and occupancy.
  - c. Report from testing and inspecting agency indicating results of IAQ testing and documentation showing compliance with IAQ testing procedures and requirements.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For LEED coordinator.
- C. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
  - 1. Plumbing.
  - 2. Mechanical.
  - 3. Electrical.
  - 4. Specialty items, such as elevators and equipment.
- D. Sustainable Design Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to Proceed, indicating how the following requirements will be met:

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1. List of proposed products with EPDs.
  2. List of proposed products complying with requirements for multi-attribute optimization.
  3. List of proposed products complying with requirements for sourcing of raw materials.
  4. List of proposed products complying with requirements for material ingredient reporting.
  5. List of proposed products complying with requirements for material ingredient optimization.
  6. Waste management plan complying with Section 017419 "Construction Waste Management and Disposal."
  7. Construction IAQ management plan.
  8. IAQ assessment plan.
- E. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with sustainable design action plans.

1.7 QUALITY ASSURANCE

- A. LEED Coordinator: Engage an experienced LEED AP to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide products and procedures necessary to obtain LEED credits indicated as Contractor's responsibility. Although other Sections may specify some requirements that contribute to these LEED credits, Contractor provides additional materials and procedures necessary to obtain LEED credits indicated.
- B. At least 20 different products from at least five different manufacturers have EPDs that comply with LEED requirements. Product-specific Type III EPDs are valued as one and one-half of a product.
- C. Recycled Content: Building materials have recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content for Project constitutes a minimum of 15 percent of cost of materials used for Project.
1. Cost of postconsumer recycled content plus one-half of preconsumer recycled content of an item to be determined by dividing weight of postconsumer recycled content plus one-half of preconsumer recycled content in the item by total weight of the item and multiplying by cost of the item.
  2. Do not include plumbing, mechanical and electrical components, and specialty items, such as elevators and equipment, in the calculation.

2.2 LOW-EMITTING MATERIALS

- A. Paints and Coatings: For field applications that are inside the weatherproofing system, 75

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percent of paints and coatings meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations.

- B. Adhesives and Sealants: For field applications that are inside the weatherproofing system, 75 percent of adhesives and sealants meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations.
- C. Flooring: A minimum of 90 percent of flooring products meet the VOC emissions evaluation or inherently non-emitting sources criteria or salvaged and reused materials criteria. Subflooring is excluded.
- D. Walls: A minimum of 75 percent of wall panel products meet the VOC emissions evaluation or inherently non-emitting sources criteria or salvaged and reused materials criteria. Wall panel products include wall paneling, wall coverings, wall tile, surface wall structures, cubicle/curtain/partition walls, trim, doors, frames, windows, and window treatments. Removable/interchangeable fabric panels, built-in cabinetry, and vertical structural elements are excluded.
- E. Ceilings: A minimum of 90 percent of ceilings meet the VOC emissions evaluation or inherently non-emitting sources criteria or salvaged and reused materials criteria. Ceiling products include ceiling panels, ceiling tile, surface ceiling structures, suspended systems, and glazed skylights. Overhead structural elements are excluded.
- F. Insulation: A minimum of 75 percent of insulation products meet the VOC emissions evaluation. Insulation products include all thermal and acoustic boards, batts, rolls, blankets, sound attenuation fire blankets, and foamed-in-place, loose-fill, blown, and sprayed insulation. HVAC duct and plumbing piping insulation are excluded.
- G. Composite Wood: A minimum of 75 percent of all composite wood meet the formaldehyde emissions evaluation or salvaged and reused materials criteria. Composite wood materials include particleboard, MDF, hardwood veneer plywood, and structural composite wood.

PART 3 - EXECUTION

3.1 NONSMOKING BUILDING

- A. Smoking is not permitted within the building or within 25 ft. of entrances, operable windows, or outdoor-air intakes.

3.2 CONSTRUCTION WASTE MANAGEMENT

- A. Comply with Section 017419 "Construction Waste Management and Disposal."

3.3 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT

- A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

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1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install MERV 8 filter media in accordance with ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace air filters immediately prior to occupancy with new filters specified in Section 234100 "Particulate Air Filtration."

### 3.4 INDOOR AIR QUALITY (IAQ) ASSESSMENT

#### A. Flush-Out:

1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14,000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
  - a. The geothermal heating and cooling systems must be fully operational before using building equipment for flush out. During flush out the AHUs shall operate in economizer mode and the AHU mounted airflow measuring stations shall record the total volume of outside air introduced to the building. The DOAS units shall operate as specified and the unit mounted airflow measuring stations shall record the total volume of air introduced to the building. Indoor conditions shall be maintained as described above. The flush out will be complete when the areas served by each AHU or DOAS have received the following total outside air volumes:

AHU-1 + DOAS-1:	3,803 sq ft = 53,242,000 cubic feet
AHU-2 + AHU-3 + DOAS-2:	7,870 sq ft = 109,900,000 cubic feet
DOAS-3:	6,543 sq ft = 91,602,000 cubic feet
AHU-4 + DOAS-4:	14,362 sq ft = 201,068,000 cubic feet
DOAS-5:	4,740 sq ft = 65,940,000 cubic feet
2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it is ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside-air rate prerequisite, whichever is greater. During each day of the flush-out period, ventilation begins a minimum of three hours prior to occupancy and continues during occupancy. These conditions are maintained until a total of 14,000 cu. ft./sq. ft. of outside air has been delivered to the space.
  - a. The geothermal heating and cooling systems must be fully operational before using building equipment for flush out. During flush out the AHUs shall operate in economizer mode and the AHU mounted airflow measuring stations shall record the total volume of outside air introduced to the building. The DOAS units shall operate as specified and the unit mounted airflow measuring stations shall record the total volume of air introduced to the building. Indoor conditions shall be maintained as described above. The flush out will be complete when the areas served by each AHU or DOAS have received the following total outside air volumes:

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AHU-1 + DOAS-1:	3,803 sq ft = 53,242,000 cubic feet
AHU-2 + AHU-3 + DOAS-2:	7,870 sq ft = 109,900,000 cubic feet
DOAS-3:	6,543 sq ft = 91,602,000 cubic feet
AHU-4 + DOAS-4:	14,362 sq ft = 201,068,000 cubic feet
DOAS-5:	4,740 sq ft = 65,940,000 cubic feet

END OF SECTION

SECTION 018123 - FACILITY SEISMIC AND WIND CRITERIA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section specifies basis-of-design seismic and wind criteria for nonstructural components on the Project.

1.2 SEISMIC CRITERIA

- A. Unless otherwise indicated on the Contract Documents, the specified Work must withstand seismic events in accordance with requirements specified in this Section, adjusted for installed elevation above or below grade.
- B. Engage qualified structural engineer to perform calculations necessary for the installed Work to comply with seismic requirements. Perform calculations using methods acceptable to authorities having jurisdiction and as specified in this Section.
  - 1. Data indicated below to be determined must be obtained by Contractor and must be included in individual component submittal packages.
- C. Applicable Seismic Design Standard: ASCE/SEI 7-2010 including supplement No. 1.
- D. Facility Seismic Factors:
  - 1. Mean Roof Height of Structure (h): Determine from the Drawings.
  - 2. Building Occupancy Risk Category: II.
  - 3. Building Site Classification: D.
- E. Component Seismic Factors:
  - 1. The following seismic factors are specified separately in the Specifications for each product or are scheduled on the Drawings:
    - a. Component importance factor ( $I_p$ ).
    - b. Component amplification factor ( $a_p$ ).
    - c. Component response modification factor ( $R_p$ ).
    - d. Component overstrength factor ( $\Omega_o$ ).
  - 2. Height of Component's Attachment to Structure (z): Determine from the Drawings. For items at or below the base of the structure, "z" must be taken as zero.
  - 3. Component Operating Weight ( $W_p$ ): Determined from manufacturer's product data.
- F. Seismic Calculation Factors for Nonstructural Components, ASCE/SEI 7, Ch. 13:
  - 1. Horizontal Seismic Design Force  $F_p$ : In accordance with Equation 13.3-1 from the following factors:



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- a. Spectral Acceleration ( $S_{DS}$ ): 0.244.
2. Vertical Seismic Design Force: In accordance with Paragraph 13.3.1.
3. Seismic Relative Displacement ( $D_{pl}$ ): In accordance with Paragraph 13.3.2 from the following factors:
  - a. Relative Seismic Displacement that Each Component Must Be Designed to Accommodate ( $D_p$ ): In accordance with Paragraph 13.3.2.
  - b. Structure Importance Factor ( $I_e$ ): 1.00. Value applies to all components on the Project.
  - c. Deflection at Building Level x of Structure A ( $\delta_{xA}$ ): Determine from the Drawings.
  - d. Deflection at Building Level y of Structure A ( $\delta_{yA}$ ): Determine from the Drawings.
  - e. Deflection at Building Level y of Structure B ( $\delta_{yB}$ ): Determine from the Drawings.
  - f. Height of Level x to Which Upper Connection Point Is Attached ( $h_x$ ): Determine from the Drawings and manufacturer's product data.
  - g. Height of Level y to Which Upper Connection Point Is Attached ( $h_y$ ): Determine from the Drawings and manufacturer's product data.
  - h. Allowable Story Drift for Structure A ( $\Delta_{aA}$ ): Determine from the Drawings.
  - i. Allowable Story Drift for Structure B ( $\Delta_{aB}$ ): Determine from the Drawings.
  - j. Story Height Used in the Definition of the Allowable Drift  $\Delta_a$  ( $h_{sx}$ ): Determine from the Drawings.

### 1.3 WIND CRITERIA

- A. Engage qualified structural engineer to perform calculations necessary for the installed Work to comply with wind requirements. Perform calculations using methods acceptable to authorities having jurisdiction and as specified in this Section.
  1. Data indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
  2. Coordinate wind design calculations with seismic design calculations for equipment requiring both seismic and wind controls.
- B. Applicable Wind Design Standard: ASCE/SEI 7-2010 including supplement No. 1.
- C. Facility Wind Factors:
  1. Mean Roof Height of Structure (h): Determine from the Drawings.
  2. Building Occupancy Risk Category: II.
- D. Wind Calculation Factors for Nonstructural Components, ASCE/SEI 7, Ch. 30:
  1. Calculate design wind pressure "p" for external sidewall-mounted equipment in accordance with one of the following, as appropriate:
    - a. PART 1: Low-Rise Buildings.
    - b. PART 2: Low-Rise Buildings (Simplified).
    - c. PART 3: Buildings with "h" less than 60 ft.
  2. Calculate design wind pressure "p" for rooftop equipment using methods in accordance with PART 6: Building Appurtenances and Rooftop Structures and Equipment.

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- a. Basic Wind Speed (V): 109 MPH.
  - b. Wind Directionality Factor ( $K_d$ ): 0.85.
  - c. Exposure Category: C.
  - d. Topographic Factor ( $K_{zt}$ ): 1.37.
  - e. Velocity Pressure Exposure Coefficient (Evaluated at Height z) ( $K_z$ ): Determine from ASCE/SEI 7-10 Table 29.3-1 based on applicable height.
  - f. Velocity Pressure Exposure Coefficient (Evaluated at Height h) ( $K_h$ ): Determine from ASCE/SEI 7-10 Table 29.3-1 based on applicable height.
  - g. Velocity Pressure at Height z ( $q_z$ ): In accordance with Section 26.10.1 or other source approved by authorities having jurisdiction.
  - h. Velocity Pressure at Height h ( $q_h$ ): In accordance with Section 26.10.1 or other source approved by authorities having jurisdiction.
- 1) Gust-Effect Factor (G): 0.85.
  - 2) Enclosure Classification: Enclosed.
  - 3) Internal Pressure Coefficient ( $GC_{pi}$ ): Plus 0.18 and minus 0.18.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 08123

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SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, specifications and other general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Sections, apply to this Section.
- B. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the Related Documents and Conditions identified in Division 01 Sections.
- C. Owner's Project Requirements (OPR) and the Basis of Design (BOD) documentation prepared by the Owner and Architect / Engineer, respectively, contain requirements that apply to this section.
- D. Related Sections
  - 1. Division 3, Section 033000 Cast in place Concrete
  - 2. Division 4, Section 042000 Unit Masonry
  - 3. Division 7 (ALL SECTIONS)
  - 4. Division 8 (ALL SECTIONS)
  - 5. Division 22 (ALL SECTIONS)
  - 6. Division 23 (ALL SECTIONS)
  - 7. Division 26 (ALL SECTIONS)

1.2 SUMMARY

- A. This section includes requirements for Commissioning during the pre-design phase, design phase, construction phase and the building turnover phase. This section includes general Commissioning requirements for all specified and associated systems, sub systems and equipment. The intent of this section is to specify the Commissioning responsibilities of the Construction Manager / General and their subcontractors (referred to herein as the Contractor, Heating, Ventilation and Air conditioning (HVAC) Subcontractor, Testing, Adjusting and Balancing (TAB) Subcontractor, Automated Temperature Controls (ATC) Subcontractor, Electrical Subcontractor, Plumbing Subcontractor, etc..). The Contractor will assure participation and cooperation of their Subcontractors as required throughout the duration of the Commissioning process.

1.3 DEFINITIONS

- A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor.
- B. Automated Temperature Controls (ATC): This term is inclusive of any and all automated controls, building management systems, energy management systems and their various networks, software and components.

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- C. Basis of Design (BOD): A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- D. Commissioning Authority (CxA): The individual or group engaged under separate contract to the Owner responsible for executing the Commissioning requirements.
- E. Commissioning Plan: An informational document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning process.
- F. Contractor: The prime contractor (Construction Manager or General Contractor) identified in the Contract for Construction between Owner and Contractor.
- G. Engineer of Record: Includes the design Engineer(s) identified in the Contract for Construction between Owner and Contractor, responsible for design of HVAC, electrical, communications, controls for HVAC systems and other related building systems.
- H. Owner's Project Requirements (OPR): A document that details the program requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- I. Pre-Functional Checklists: The CxA will produce pre-functional checklists that can be used by the Contractor and Subcontractors prior to the start of functional testing. These checklists are tools to help the Subcontractors verify that the installation complies with the Contract Documents and is complete and ready for functional performance testing. The pre-functional checklists will be created for all applicable equipment included in the Scope of Work identified in section 1.10 of this Section.
- J. Subcontractor: Installing contractors responsible to the Contractor for installation of systems and equipment. This term is inclusive of all trades (HVAC, electrical, plumbing, etc.).
- K. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- L. Systems Manual: Collective documentation prepared in the form of a manual to allow easy navigation of its contents. Contents of the manual are defined by the Owner with the help of the CxA, and assembled by the Contractor at project close-out. Manual contents may incorporate other close-out documents (e.g. O&M's, emergency manuals, warranty documents, etc.).
- M. Testing, Adjusting, and Balancing (TAB): Includes any and all testing, adjusting and balancing as performed by the TAB Subcontractor.

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor and Subcontractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The Commissioning Team shall consist of,

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but not be limited to, representatives of the Contractor and of each Subcontractor, including project superintendents, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. The CxA: Owner has engaged the CxA under a separate contract.
2. Representatives of the Owner including facility users and operation and maintenance personnel.
3. Architect and Engineer of Record.

1.5 OWNER'S RESPONSIBILITIES

A. Owner shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in commissioning process activities including, but not limited to, the following:

1. Coordination and functional performance testing meetings.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration of operation of systems, subsystems and equipment.
4. Participate, as needed, in performing deferred or opposite seasonal testing of systems and equipment.
5. Participate, as needed, in the post-occupancy system performance review 10 months into the 12 month warranty period.
6. Provide, where applicable, any information and effort needed to support the development of the Systems Manual.

1.6 DESIGN TEAM'S RESPONSIBILITIES

B. Design Team shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in commissioning process activities including, but not limited to, the following:

1. Participate in functional performance testing of systems to be commissioned (where applicable based on complexity of system or uniqueness of design).
2. Resolve issues identified during commissioning. Provide responses to open issues within two weeks of being posted via online web-based tracking database (SES Commissioning Portal).
3. Participate, as needed, in performing deferred or opposite seasonal testing of systems and equipment.
4. Participate, as needed, in the post-occupancy system performance review 10 months into the 12 month warranty period.
5. Provide, where applicable, any information and effort needed to support the development of the Systems Manual.

1.7 CONTRACTOR'S AND SUBCONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

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1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
  2. Provide the CxA with a detailed and accurate construction schedule updated on a monthly basis. Coordinate scheduling of commissioning activities with the CxA and include them in the construction schedule.
  3. Provide a schedule for equipment submittals, installation manual submittals, operation and maintenance data submittals, equipment start-up, and testing to CxA for incorporation into the commissioning plan. Update schedule on a monthly basis throughout the construction period.
  4. Provide CxA with copies of all approved change orders, SK's, or other modifications impacting construction when approved.
  5. Participate in construction phase coordination meetings.
  6. Participate in commissioning field observations.
  7. Confirm accurate and successful completion of construction checkout documents (pre-functional checklists) for all systems to be commissioned prior to verification site visits and functional testing by the CxA.
  8. Certify readiness of systems to be commissioned prior to functional performance testing.
  9. Participate, as needed, in functional performance testing of systems to be commissioned.
  10. Provide field quality control testing and inspection reports for all systems including envelope systems where called for in individual sections.
  11. Resolving issues identified during commissioning and coordinating correction of deficiencies. Provide responses to open issues within two weeks of being posted via online web-based tracking database (SES Commissioning Portal).
  12. Participate in operation and maintenance planning and verification.
  13. Participate in operation and maintenance training sessions.
  14. Participate in final review at acceptance meeting.
  15. Certify the work is complete and systems are operational according to the contract documents, including calibration of controls and any instrumentation.
  16. Coordinate Subcontractor participation in commissioning activities.
  17. Assist in coordinating the Subcontractors, as needed, to provide project close-out documentation such as system manual, record documentation and training documentation.
  18. Assemble Systems Manual at project close-out in accordance with the approved Systems Manual Outline. If required, convene meeting with Owner to understand requirements of manual assembly.
  19. Assist in coordinating the Subcontractors, as needed, to perform testing of systems and equipment as it relates to project phasing.
  20. Assist in coordinating the Subcontractors, as needed, to perform deferred or opposite seasonal testing of systems and equipment. Assist in coordinating the Subcontractors to resolve issues discovered as a result.
  21. Assist in coordinating the Subcontractors to resolve issues discovered during the system performance review 10 months into the 12 month warranty period.
- B. Subcontractor(s) shall assign representatives with the expertise and the authority to act on behalf of the entity responsible for installation of systems to be commissioned who shall participate in and perform commissioning team activities including, but not limited to, the following:
1. Provide a schedule for equipment submittals, installation manual submittals, operation and maintenance data submittals, equipment start-up, and testing to CxA for incorporation into the commissioning plan. Update schedule on a monthly basis throughout the construction period.

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2. Participate in construction phase coordination meetings.
3. Provide information to the CxA for developing construction phase commissioning plan including, but not limited to:
  - a. Schedule as mentioned above
  - b. Equipment submittals
  - c. Installation manual submittals
  - d. Operation and maintenance information submittals
4. Confirm accurate and successful completion of construction checkout documents (pre-functional checklists) for all systems to be commissioned prior to verification site visits and functional testing by the CxA.
5. Maintain updated Project Record Documents for periodic review by the CxA and submit final record documents at project completion.
6. Certify readiness of systems to be commissioned prior to functional performance testing. Provide any available support documentation (start-up reports, pressure test reports, field quality reports, etc.).
7. Participate in functional performance testing of systems to be commissioned when requested by the CxA. Support for testing will be provided as necessary to successfully complete all Cx testing.
8. Participate in Commissioning meetings.
9. Provide technicians who are familiar with the construction and operation of the installed systems, are trained in the use of required testing instruments and procedures to participate in testing of installed systems, subsystems and equipment.
10. Participate in operation and maintenance planning, documentation and verification.
11. Resolving issues identified during commissioning and coordinating correction of deficiencies. Provide responses to open issues within two weeks of being posted via online web-based tracking database (SES Commissioning Portal).
12. Provide project close-out documentation including but not limited to system manual, operations and maintenance manuals, training documentation, etc.
13. Participate in training sessions for Owner's operation and maintenance personnel.
14. Participate in final review at acceptance meeting.
15. Participate, as needed, in performing deferred or opposite seasonal testing of systems and equipment.
16. Participate, as needed, in resolving warranty related issues discovered during the system performance review 10 months into the 12 month warranty period.

#### 1.8 COMMISSIONING DOCUMENTATION

- A. Commissioning plan: An informational document, prepared by the CxA, that outlines the schedule, allocation of resources and documentation requirements of the commissioning process, including:
  1. Plan for delivery and review of submittals, Systems Manual and other documents and reports. Identification of the relationship of these documents to other functions and a description of submittals that are required to support the commissioning processes. Submittal dates include the latest date approved submittals must be received without adversely affecting commissioning.
  2. Overview of the organization, layout and content of commissioning documentation and a description of documents to be provided along with identification of responsible parties.
  3. Identification of systems and equipment to be commissioned.

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4. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
  5. Identification of items that must be completed before the next operation can proceed.
  6. Description of responsibilities of commissioning team members.
  7. Description of requirements for operation and maintenance training, including required training materials.
  8. Description of expected performance for systems, subsystems, equipment and controls.
  9. Requirements for documenting changes on a continuous basis to appear in the project record documents.
  10. Process and schedule for completing construction checklists for systems to be commissioned.
  11. Step by step procedures for testing systems, subsystems and equipment with descriptions for methods of verifying relevant data, recording the results obtained and listing parties involved in performing and verifying tests.
- B. Pre-functional Checklists: CxA shall develop pre-functional checklists for each system to be commissioned including all interfaces and interlocks. Separate entries will be provided for each item to be checked. Pre-functional checklists will be completed by the installing Subcontractor and verified by the Contractor and CxA. Space will be provided for sign off of installing Subcontractor, Contractor and CxA. The successful completion of the prefunctional checklists for systems and equipment is mandatory prior to any functional testing being performed. The successful completion of these checklists without outstanding issues indicates the equipment/systems full readiness for successful functional testing. **Falsely indicating successful completion of the checklists and resulting failures of functional testing will result in the responsible contractor being responsible for the cost of retesting.** Each checklist will include, but not limited to, the following:
1. Name and identification code of each item being checked.
  2. Verification of each item including verification of all required data and construction practices listed in the construction checklists. This list outlines all work necessary to be completed prior to the start of functional testing for the particular system, subsystem and equipment.
  3. Notation of any equipment or installation that deviates from approved submittals or the construction documents.
  4. Name(s) of personnel involved with verification and dates on which verification activities and construction checklists were completed.
- C. Field Observation Reports: The CxA will issues periodic field observation reports resulting from site visits made throughout construction. The reports will be submitted to the Owner and the Contractor for distribution to the Subcontractor and include, but are not limited to, the following:
1. Witnessing systems, assemblies, equipment, and component startup.
  2. Cleanliness and proper storage of construction materials like duct work, refrigerant piping, etc.
  3. Observed installation deficiencies and/or deviations from the Contract Documents.
- D. Certificate of Readiness: Certificate of Readiness shall be signed by the Contractor, Subcontractor(s), and Installer(s) certifying that systems, subsystems, equipment, and associated controls are ready for functional performance testing and that all relevant information including submittals, installation data and operation and maintenance documentation has been submitted. Completed pre-functional checklists signed by the responsible parties shall accompany this

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**certificate. Falsely indicating readiness and resulting failures of functional testing will result in the responsible contractor being responsible for the cost of retesting.**

- E. Functional Performance Test Procedures: The CxA shall develop functional performance test sheets for each system to be commissioned including interfaces and interlocks. Separate entries will be provided for each item to be tested. CxA shall prepare separate tests for each mode of operation and provide space to indicate whether the mode under test responded as required. All information gathered will be documented by the CxA. Each test will include, but not limited to, the following:
1. Name and identification of each item being checked.
  2. Date of test.
  3. Indication of whether the record is for a first test or retest following correction of a problem or issue.
  4. List of deficiencies.
  5. Calibration of sensors and sensor function.
  6. Testing conditions under which test was conducted, including (where applicable) ambient conditions, setpoints, override conditions, and status and operating conditions that impact the results of the test.
  7. Control sequences for mechanical and electrical systems.
  8. Verification of control signals for each setpoint at specified conditions.
  9. Responses to control signal at specified conditions (where applicable).
  10. Sequence of responses to control signals at specified conditions.
  11. Electrical demand or power input at specified conditions (where applicable).
  12. Expected performance of systems, subsystems and equipment at each step of the tests. Narrative description of observed performance of systems, subsystems and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
  13. Interaction with ancillary equipment.
- F. Training Plans: To be prepared by the Contractor and Subcontractors and submitted to the CxA and the Owner for review and comment prior to finalizing training plans.
- G. Systems Manual: To be prepared by the Contractor and shall incorporate the requirements listed in the Systems Manual Outline. The Systems Manual shall be easy to navigate with a Table of Contents for each volume, and may require other close-out documents to be incorporated (e.g., O&M's, training documentation, warranty contracts). Format for final delivery shall be electronic, unprotected, bookmarked and searchable.
- H. Commissioning Issues Log: The CxA will document any and all deficiencies and corrective actions taken for systems and equipment that fail initial functional performance tests including required modifications to systems and equipment and revisions to functional performance test procedures. Re-tests and final results will also be documented.
1. Commissioning Notice: CxA prepares and maintains an issue log that describes design, installation and performance issues that are at variance with the OPR, BOD and Contract Documents. Identification and tracking of issues as they are encountered, documenting the status of unresolved and resolved issues. The issues log is shared with members of the Commissioning team via an interactive web-based portal which is maintained by the CxA.

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- a. SES Commissioning Portal: The interactive web-based portal is an on-line database maintained by Sustainable Engineering Solutions, LLC. The portal is used by the CxA to track issues and assign responsibility for corrective action.
- b. All members of the Commissioning Team will be given access to the portal as required to respond to issues or deficiencies. Issues can be sorted based on responsibility, status, date posted and issue tag.
- c. Issues status will begin as “Open” until the responsible Contractor or Subcontractor addresses the issue stating that corrective action has been performed.
- d. Once the Contractor / Subcontractor have addressed the issue stating that corrective action has been performed the issue status will be changed to “Pending Verification” as the issue awaits re-verification by the CxA.
- e. After the CxA has confirmed that the corrective action has taken place, as stated by the responsible Contractor or Subcontractor, the issue status will be indexed to “Closed” but remain visible for record purposes.

1.9 SUBMITTALS BY CONTRACTOR

- A. Information listed below shall be submitted with the product and system literature and shop drawing submittals for review and approval by the Owner, Architect, Engineer of Record and the CxA. This information will be used to confirm the product compliance with the Contract Documents and to establish detailed commissioning requirements and procedures. The information shall be specific to each system to be commissioned and shall be inclusive of all related systems, equipment and components.
- B. Systems Manual
  1. The Contractor shall coordinate with the CxA to develop the Systems Manual in accordance with the requirements identified in Divisions 01 and the specific requirements identified in each Section.
  2. The Contractor and Subcontractor shall convene a meeting with the owner to discuss expectations of the systems manual assembly format and delivery method.
  3. The Systems Manual shall contain all required information under a single cover unless otherwise indicated and shall include, but not be limited to the following:

SYSTEMS MANUAL OUTLINE:

- a. Executive Summary (Description of manual contents and intention)
  - b. Construction Record Documents (As-builts, TAB final report, ATC as-built, approved submittals, Conformed Drawings, RFI Logs, etc..)
  - c. Warranties
  - d. Project Operations and Maintenance Manuals (as specified)
4. The Systems Manual documentation shall be provided in digital or hard copy format (at owner’s discretion), Shall be unlocked, searchable, and easily navigable. The manual shall be structured with a table of contents per the sections indicated above.

1.10 COORDINATION

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- C. Pretesting Meetings: The CxA shall conduct pretest meetings with the Commissioning Team prior to the start of the functional performance testing to review start-up reports, pretest verification results, testing procedures, testing personnel and instrumentation requirements and manufacturer's authorized service representative services for each system, subsystem, equipment and component to be tested.
- D. Field Observations: The CxA shall conduct periodic field observations of the exterior enclosure during construction. The Contractor must notify the CxA at least one week prior to completion of key milestones, assemblies and sub-system components installation and functional testing (e.g. infrared scanning, mass water infiltration, etc.) so that site visits can be coordinated while access is available to witness. If the CxA is not notified prior to final assembly then finished sections may have to be disassembled for review at no cost to the owner. Any costs associated with dissembling and re-assembling components shall be borne solely by the contractor.
- E. Coordination During Functional Performance Testing: The CxA shall coordinate sequence of testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and verification.
- F. Manufacturer's Field Services: The Subcontractor(s) shall be responsible for coordinating services from the manufacturer's representative, technicians or vendors as needed. The CxA will coordinate when these services are required and notify the Subcontractor(s) at least one week prior to scheduled functional performance testing.

1.11 ENVELOPE COMMISSIONING

- A. Intent: The CxA will work closely with the Owner, design team, and the installing contractors to help establish a level of quality for the envelope systems on the project.
- B. The statement above is accomplished through a review of submittals, project details, manufacturer guidelines and contractor coordination meetings. Once that level of quality is established, the CxA will provide periodic observations of systems throughout construction to help assure ongoing quality. The CxA shall not be considered an inspector nor be responsible to observe every section or application of these systems.
- C. Where deficiencies are observed and reported by the CxA, it is the responsibility of the contractor to not only correct the area of the system reported, and to document the corrective actions, but to assure these deficiencies are corrected throughout, prior to being enclosed with the exterior façade or interior finishes. The contractor is responsible for installing systems and materials in compliance with the project documents and with manufacturers practices.
- D. See section 3.6 for testing requirements.

1.12 SYSTEMS TO BE COMMISSIONED

- E. The following systems, subsystems, equipment and components will be commissioned and will be referred to collectively herein as the Systems to be Commissioned:

HVAC

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1. Hot water heating systems (wood chip boiler, gas fired boilers, pumps, chemical treatment, make-up water system)
2. Chilled water systems (Chillers Pumps, make-up water, chemical treatment,)
3. Ventilation systems (AHU's, ERV's, MAU, etc.)
4. VAV boxes (25% sampling)
5. Fan coil units
6. Ductless split A/C
7. Toilet and general exhaust
8. Kitchen hood fans
9. Destratification fans
10. Cabinet and Unit heaters (25% sampling)
11. Radiant floors (25% sampling)
12. Sampling or air and water balance, including pressurization
13. Building Automation System interface with above equipment

PLUMBING

14. Domestic hot water system (generation, distribution, heat tracing)
15. Trap primers
16. Booster pumps
17. Elevator sump pumps
18. Building Automation System as it relates to above equipment

ELECTRICAL

19. Generator and Transfer Switching
20. Lighting Controls (daylighting, occupancy sensors, timer switches)
21. Building Automation System as it relates to above equipment

BUILDING ENVELOPE

22. Foundation waterproofing
23. Building Air Vapor Barrier system
24. Roofing system
25. Review of mock-up assemblies
26. Window installation, flashing, and witness of testing
27. Thermal imaging of wall envelopes for thermal bridging and missing insulation

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard and non-standard testing equipment required to perform start-up, initial checkout and functional performance testing shall be provided by the Division contractor for the equipment being tested. This includes any equipment, such as ladders or man lifts, necessary to gain access to systems or equipment to be commissioned.
- B. The ATC sub contractor will be responsible for providing any available software to interface with the automated temperature control system for functional performance testing purposes. If

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necessary due to licensing restrictions the ATC contractor will be responsible for providing a computer as well to operate the software.

- C. The ATC sub contractor will be responsible for securing access to any available networks (wireless or local) for use with web-based control systems. The ATC contractor will be responsible for providing user access to the web-based control system for the CxA to facilitate functional performance testing.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in applicable Divisions. The Subcontractor's instrumentation shall meet the following standards:
  - 1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required to determine adequate performance.
  - 2. Be calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used.
  - 3. Be maintained in good repair and operating condition throughout the duration of use on this project.
  - 4. Be recalibrated / repaired if dropped and/or damaged in any way since last calibrated.

### PART 3 - EXECUTION

#### 3.1 FUNCTIONAL PERFORMANCE TESTING REQUIREMENTS

- A. The requirements identified in this section are applicable to the functional performance testing of all system and equipment to be commissioned.
- B. The objective of functional performance testing is to demonstrate that each system is operating in accordance with the performance identified in the Contract Documents through systematic testing and documentation. The intent is to bring the systems from a state of substantial completion to full dynamic operation and documenting the performance. Additionally, during the functional performance testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
- C. The CxA shall achieve this objective by developing individual systems testing procedures which, when executed systematically by the Subcontractor(s), will allow the CxA to observe operation, evaluate performance, identify deficiencies, recommend modifications, adjust, and document the systems and systems equipment performance over a range of load and functional levels.
- D. In general, each system to be commissioned shall be made to operate through all modes of operation where there is a specified system response. Verifying each sequence identified in the Contract Documents is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no air or water flow, equipment general failure, etc. shall be tested.

#### 3.2 COORDINATION AND SCHEDULING OF FUNCTIONAL PERFORMANCE TESTING

- A. Scheduling of the Subcontractor(s) and personnel required to execute the functional performance testing is the responsibility of the Contractor.

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1. Commissioning activities shall be scheduled by the CxA and forwarded to the Contractor for distribution to the Subcontractors.
  2. The Contractor shall be responsible for integrating functional performance testing and commissioning requirements into the master activity schedule.
- B. The Subcontractor(s) shall provide sufficient notice to the CxA regarding their completion schedule for the pre-functional checklists and system start-up of all equipment and systems to be commissioned.
1. Subcontractors are responsible for execution of all tests.
- C. Functional performance testing is conducted after pre-functional checklists, field quality testing, and start-up procedures have been satisfactorily completed and documentation has been submitted and approved.
- D. The Contractor shall verify completeness of the exterior enclosure to facilitate the functional performance testing of the various systems and sub system assemblies.
- E. The Contractor shall verify completeness of the building envelope, perimeter and interior items which affect proper operation and control of HVAC, Plumbing and Electrical equipment and systems.
- F. The testing, adjusting and balancing of both air and hydronic systems shall be completed and any noted issues addressed before functional performance testing of air and water related equipment or systems. A preliminary report of the TAB Subcontractor's findings shall be submitted prior to the start of functional performance testing.

### 3.3 PREREQUISITE START-UP VERIFICATION

- A. Before any system start-ups begin, the Subcontractor(s) shall conduct a final installation verification audit for their work. The Contractor shall be responsible for completion of all work including change orders and punch list items to the Owner's satisfaction.
- B. Detailed test reports resulting from testing of any exterior enclosure (window, door, curtain wall, etc.) mock-ups performed by the installing contractor or third-party entity prior to or during construction.
- C. Each system, sub system, piece of equipment and component shall receive a full checkout. No sampling strategies are to be used. This checkout of the various Systems to be Commissioned shall verify that all components are properly installed. Examples of the level of checkout expected for specific systems have been included below:
1. Heating and Cooling Systems Equipment and Piping:
    - a. Service access is acceptable.
    - b. Proper cycling.
    - c. Excessive noise, vibration or leaks.
    - d. Presence of safety devices and controls.
    - e. Proper identification of all piping, valves, starters and equipment.

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- f. Pressure testing and flushing of systems has been completed.
  - g. Power available to equipment.
  - h. Temperature controls are complete.
  - i. Equipment start-up and checkout by the manufacturer's representatives are complete.
  - j. Air and water balancing is complete and a preliminary report available.
- 2. Plumbing Systems and Equipment:
  - a. Service access is acceptable.
  - b. Proper cycling.
  - c. Excessive noise, vibration or leaks.
  - d. Presence of safety devices and controls.
  - e. Proper identification of all piping, valves, starters and equipment.
  - f. Pressure testing and flushing of systems.
  - g. Power available to equipment.
  - h. Equipment start-up and checkout by the manufacturer's representatives are complete.
- 3. Building Electrical System and Equipment:
  - a. Service access is acceptable to generator and transfer switches.
  - b. Proper cycling.
  - c. Excessive noise or vibration.
  - d. Presence of safety devices and controls.
  - e. Proper identification of all starters, switches and equipment.
  - f. Power available to equipment.
  - g. Equipment start-up and checkout by the manufacturer's representatives are complete.
  - h. Integration with the building automation system is complete where applicable in the division 23 sequence of operation
  - i. Fire alarm system is complete and all devices are communicating with the fire alarm master panel.
  - j. All emergency lighting is in place and power is complete.
  - k. Calibration of all sensors, switches, transducers and related control components shall be included as part of the installation verification performed by the Subcontractor(s).
- 4. Building Envelope Systems:
  - a. Underground water proofing/membranes are in-place with water proofing integrity.
  - b. Grouting and caulking of masonry walls complete and sufficient to prevent excessive air infiltration between joints.
  - c. Airshafts are airtight with vapor barriers in place.
  - d. Exterior walls: sufficient integrity to prevent excessive infiltration with the specified insulation in place:
    - 1) Window gasketing/window assemblies complete.
    - 2) Window to wall joints caulking complete.
    - 3) Panel joints caulking complete.
    - 4) Doorframes caulking complete.

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- 5) Exterior wall insulation complete.
- 6) Air and vapor barrier integrity complete.
- 7) Roof to parapet joints complete
- 8) Flashing integrity complete
- 9) Roof insulation complete

- D. If any work is found incomplete, incorrect, or non-functional, the Subcontractor(s) shall correct the deficiencies before system start-up work proceeds.

### 3.4 SYSTEM START-UP

- A. The Contractor shall confirm that all start-up procedures take place and are documented in accordance with the requirements identified in Divisions 1 and the specific requirements identified in each Section.
- B. A start-up plan shall be developed and submitted by the Contractor to the CxA for review. The Contractor shall be responsible for coordinating the Subcontractor(s), manufacturer's representatives and certified start-up technicians. The Contractor shall commence with system start-up after approval has been given to the start-up plan and after initial inspections by the Subcontractor(s) have been completed. The CxA shall be notified via a system start-up schedule for witness of system start-up on selected systems to be commissioned.
  - 1. The Subcontractor(s) shall be responsible for submitting system start-up documentation in accordance with the requirements identified in Division 1 and the specific requirements identified in each Section. Subcontractor shall provide the following:
    - a. Manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
    - b. Manufacturer's standard issue field checkout sheets.
    - c. All documentation to include the date the start-up was performed and the name and credentials of the technician that performed it.
  - 2. The Contractor shall take corrective action on all system deficiencies noted and demonstrate to the CxA suitable system operation can be maintained. Approval from the manufacturer's representative or certified technician that originally discovered the deficiency is required.

### 3.5 PREREQUISITE FUNCTIONAL TESTING VERIFICATION

- A. The Contractor shall certify that systems to be commissioned have been completed, calibrated and start-up procedures have been completed. The Contractor shall verify that the systems to be commissioned are operating according to the Contract Documents and the Certificates of Readiness are signed and submitted.
- B. The Contractor shall certify that instrumentation and automated temperature controls associated with the systems to be commissioned have been completed and calibrated and are operating according to the Contract Documents and that preset set points have been recorded. A copy of the point-to-point checkout and sequence verification documents, resulting from the ATC sub contractor start-up, shall be provided to the CxA for review.

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- C. The Contractor shall certify that the TAB procedures have been completed and that TAB preliminary reports have been submitted, discrepancies corrected and corrective work approved. The Contractor shall confirm that the equipment interface with monitoring and control system and TAB criteria, and where specified, the calibration of sensors and control devices is fully completed.
- D. The Contractor shall certify that all safety cutouts, alarms and interlocks with smoke control and life safety systems during each mode of operation have been tested, discrepancies corrected and corrective work approved.
- E. The Contractor shall confirm that all pre-functional check lists have been completed.

### 3.6 FUNCTIONAL PERFORMANCE TESTING

- A. The responsible Subcontractor will execute the functional performance testing under the direction of the CxA. The CxA shall observe the functional performance test procedures for all of the sub systems, equipment and components associated with the systems to be commissioned.
- B. Functional performance procedures may be executed by manual adjustment (i.e. manually manipulating the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's graphic trend log capabilities.
- C. Functional performance test procedures shall be performed using design conditions whenever possible to confirm design performance.
  - 1. If design conditions are not available then the functional performance test procedures shall be performed under conditions that simulate actual conditions to the closest practical approximation.
- D. The Subcontractor executing the functional performance test procedure shall provide all necessary materials, system modifications, etc. to produce the flows, pressures, temperatures, etc. necessary to execute the test under specified conditions.
- E. At completion of the functional performance testing, the Subcontractor executing the functional performance test procedure shall return all affected building equipment and systems to their pre-test condition.
- F. The functional test procedures are meant to allow the CxA to observe, evaluate, identify deficiencies, recommend modifications, adjust, and document the systems and systems equipment performance over a range of load and functional levels. In general, functional performance testing will be performed as listed on the following systems:
  - 1. Air Distribution and Exhaust Systems:
    - a. The TAB Subcontractor shall demonstrate total airflow at each air handling and exhaust system to be commissioned at simulated full cooling, heating and/or max/min or fresh (outside) air.
    - b. Spot checks of approximately 50% of air outlets shall be made, or as requested by the CxA. The CxA shall select outlets and the TAB Subcontractor shall demonstrate

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a reading of that outlet. Where appropriate, the thermostat shall be adjusted to simulate full cooling, full heating, etc.

- c. The TAB Subcontractor shall demonstrate proper room static pressure with respect to the adjacent space(s) where applicable.
- d. The TAB Subcontractor shall demonstrate motor speed, voltage and amperage draw at selected fan motors.
- e. The TAB Subcontractor shall verify the proper calibration of temperature, pressure and safety devices as installed on the various pieces of mechanical equipment. The Testing and Balancing Contractor (TAB) shall assist the CxA in the proper setting of all temperature, pressure and safety devices.
- f. Any noted drafts or noisy air distribution devices shall be evaluated and corrective action identified.
- g. Any discrepancies between the balancing report and the spot check results shall be dealt with to correct all deficiencies. In the event that significant deficiencies are detected, the entire balancing procedure shall be repeated.

2. Hydronic Distribution Systems:

- a. The TAB Subcontractor shall demonstrate total water flows at each pump, air handler, chiller, boiler and terminal heating equipment.
- b. Spot checks of approximately 50% of hydronic balancing valves shall be made, or as requested by the CxA. The CxA shall select outlets and the TAB Subcontractor shall demonstrate a reading of that outlet. Where appropriate, the thermostat shall be adjusted to simulate full cooling, full heating, etc.
- c. The TAB Subcontractor shall demonstrate motor speed, voltage and amperage draw at selected pump motors.
- d. The TAB Subcontractor shall assist in verifying the calibration and operation of any flow meters and differential pressure sensors.
- e. The TAB Subcontractor shall assist in verifying the calibration and operation of any temperature sensors.
- f. Any discrepancies between the balancing report and the spot check results shall be dealt with to correct all deficiencies. In the event that significant deficiencies are detected, the entire balancing procedure shall be repeated.

3. Automated Temperature Controls (inclusive of all applicable systems):

- b. The ATC Subcontractor shall demonstrate the proper operation of the specified and/or approved temperature control sequences for each system, sub systems, equipment and components serving the systems to be commissioned.
- c. In addition to sequence verification, the ATC subcontractor shall demonstrate, but not limited to, the following:
  - 1) Proper display of all ATC graphics.
  - 2) Point-to-point verification and calibration of controls devices (flow stations, thermostats, glycol refractometers, etc.)
  - 3) Point-to-point verification of dampers, actuators, valves, etc.
  - 4) Demonstrate proper operation of any smoke control management systems.
  - 5) Demonstrate proper system operation when operating on emergency power.
  - 6) Demonstrate proper operation when electrical systems return back to “Normal” power.

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- d. The ATC Subcontractor shall demonstrate that a point-to-point checkout of all control points was completed.
  - 1) The control contractor and CxA will verify in the field and through the building automation system that the points both input and output actually exist and are terminated and identified correctly.
- 4. Plumbing Systems:
  - a. The plumbing Subcontractor shall demonstrate proper operation and control of the domestic water heating system including hot water heaters, storage tank circulation systems and re-circulated hot water systems.
  - b. The plumbing Subcontractor shall demonstrate proper operation and adjustment of the thermostatic mixing valves.
  - c. The plumbing Subcontractor shall demonstrate proper operation and adjustment of the elevator, and building booster pumps.
  - d. The plumbing Subcontractor shall demonstrate proper operation proper operation and of any compressed air or laboratory gas systems.
- 5. Electrical Power Systems:
  - a. The electrical Subcontractor shall demonstrate the proper operation of the emergency power system and components including transfer of power from “Normal” to “Emergency” and back to “Normal” power.
  - b. The electrical Subcontractor shall demonstrate proper operation of emergency lighting and emergency lighting control systems.
  - c. The electrical Subcontractor shall demonstrate proper operation of building and site lighting control systems and components including dimming systems, day light harvesting systems and specific user controlled functions.
  - d. The electrical Subcontractor shall demonstrate proper operation of occupancy and vacancy sensors and the integration between the lighting control system and HVAC system (where applicable).
- 6. Building Envelope Systems: Construction observation (visual confirmation) shall be performed on the following systems unless otherwise indicated:
  - a. Roofs including all penetrations, transitions, etc.
  - b. Skylights and other sloped glazing
  - c. Exterior walls, including the air barrier system, and water management systems
  - d. Windows
  - e. Doors, louvers
  - f. Sealants and expansion joints
  - g. Control joints
  - h. Flashings, including all transitions, end-dams, etc.
  - i. Curtain walls or window walls, storefront
  - j. Below-grade construction, including drainage and waterproofing/damp proofing
  - k. Floors, slab-on-grade
  - l. Interface conditions between each of the above listed elements
  - m. Witness Contractor or Subcontractor field testing (ASTM, etc.) where applicable.

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7. Envelope Testing

- a. Testing requirements are outlined in individual sections by the design team, with the help of the CxA and the owner.
- b. All performance testing of the envelope systems is the responsibility of the division contractor unless otherwise specified. Testing procedures per specified standard (ASTM, AMAA, etc) shall be presented to the CxA for review 2 weeks prior to testing being scheduled.

8. Problem Solving

- a. The CxA will recommend solutions to problems found, however the burden of responsibilities to solve, correct and retest problems rests with the Contractor, Subcontractor, Architect and Engineering of Record.

9. Trend Logs:

- a. Upon completion of successful functional performance testing the ATC contractor shall submit graphic trend logs to the Commissioning Team utilizing the trend functions of the building automation system.
- b. Trend logs shall be color graphics with a legend and include the dates, timeline and point identification (i.e. hot water supply temperature, etc.) for the trend data.
- c. Submit graphic trend logs for each piece of controlled equipment and include all necessary points and controlled parameter to clearly identify the equipment operation.
- d. Trend logs shall be submitted demonstrating successful performance for a seven (7) day period unless the controlled process requires a longer timeline.
- e. Trend log shall be submitted demonstrating successful seasonal performance.

3.7 OPPOSITE SEASON/DEFERRED FUNCTIONAL PERFORMANCE TESTING

- A. The purpose of opposite seasonal functional testing is to evaluate the performance of selected equipment during design weather conditions that may not have been available during the initial functional testing. Ideally cooling equipment needs to be functionally tested under hot, humid summer conditions to review proper operation in accordance with design specifications. The same is true for heating hot water, steam system and humidification systems which require colder, drier, winter climates.
- B. The purpose of deferred functional performance testing is to evaluate the performance of a selected system that may have been partially complete during the initial functional performance testing of the system's components. Ideally systems need to be functionally tested once completed but, due to project phasing, may be completed at the component level before being completed at the system level.
- C. The functional performance testing performed during seasonal/deferred testing will adhere to the guidelines listed above in section 3.6 in its entirety of this Section.
- D. The documentation and resolution of any noted deficiencies will be performed in accordance with section 1.7 sub section H and section 3.8 in its entirety of this Section.

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### 3.8 DOCUMENTATION OF COMPLIANCE AND NON-COMPLIANCE

#### A. Documentation:

1. The CxA will witness and document the results of the functional performance tests using the specific procedural forms (i.e. functional performance test sheets) developed for that purpose.
2. Recorded information will include measured performance data, visual observations and a comprehensive summary describing the operation of systems at the time of testing.
3. Functional performance test sheets for each controller verifying proper operation of the control system, the system it serves, the service it provides and its location will be provided.
4. All functional performance test sheets, procedural forms, etc. used to document compliant and non-compliant performance will remain the property of the CxA until the end of the project at which point they will become the property of the Owner.

#### B. Compliance

1. The CxA will record the results of the functional performance testing on each specific procedural form. Tests found to be compliant with the testing criteria stated in the procedural form will be identified as such and submitted to the Owner for approval.
2. Where applicable, additional performance information may be recorded for future use or reference by the CxA when developing additional project documentation.

#### C. Non- Compliance

1. The CxA will record the results of the functional performance testing on each specific procedural form. Tests found to be non-compliant with the testing criteria stated in the procedural form will be identified as such.
2. Corrections of minor deficiencies identified may be made during the functional performance testing at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form for record.
3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owner.
4. Should a deficiency be identified that cannot be readily corrected during the functional performance testing the CxA will notify the installing Contractor or Subcontractor. If there is no dispute regarding the nature of said deficiency then the installing Contractor or Subcontractor accepts the responsibility to correct it.
  - a. The CxA will document the deficiency, the Contractor or Subcontractor's response and their intentions and proceed to the next functional performance test.
5. If functional performance tests cannot be completed because of a deficiency outside the scope of the Contractor or Subcontractor responsible for installation of the system or equipment to be commissioned then the deficiency shall be documented and reported to the Owner.

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- a. The CxA will document the deficiency, the responsible Contractor or Subcontractor's response and their intentions and proceed to the next functional performance test.
6. After completion of the functional performance testing the CxA will publish all deficiencies through the web-based interactive commissioning database. At this point the deficiencies will be assigned a tag, responsibility and status and be known as "commissioning issues".
7. If there is any dispute regarding a specific commissioning issue or issues in general; whether the assigned responsibility or the nature of the issue are being disputed then the dispute will be documented and a copy given to the Contractor, Design Team and Owner for evaluation and resolution.
8. The intent is to make resolutions at the lowest management level possible. Other parties are brought into the discussions as needed. The Owner maintains the final interpretive authority.
9. Once the interpretation and resolution have been agreed upon by all parties, the appropriate party addresses the commissioning issue and updates the web-based interactive commissioning database indicating corrective action has taken place. The CxA will reschedule the functional performance test and the test will be repeated until satisfactory performance is achieved.
10. If it is determined that the system is constructed according to the Contract Documents the Owner will decide whether modifications required to bring the performance of the system to the OPR and BOD documents shall be implemented or if the noted performance will be accepted as submitted. If additional work is performed outside of the original project scope then the Owner will decide if functional performance testing shall be repeated and a revised functional performance test sheet submitted.

D. Cost(s) of Re-testing Non-Compliant System or Equipment

1. The cost for the Contractor or Subcontractor to perform re-testing, if they are responsible for the deficiency preventing a successful initial functional performance test, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the Owner.
2. The cost associated with the time used by the CxA to direct any re-testing required because a specific pre-functional checklist, start-up or commissioning notice issue, reported to have been successfully completed, but determined during functional performance testing to be incomplete, will be back-charged to the Contractor, who may choose to recover costs from the party responsible.

E. Failure Due to Manufacturing Defect

1. If 10% or a total of three (3), whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance, all identical units may be considered unacceptable by the CxA. In such case, the responsible Contractor or Subcontractor shall provide the Owner with the following:
  - a. Within one week of original notification the Contractor or Subcontractor shall coordinate with the vendor and/or manufacturer's representative and shall examine all other identical units making a record of the findings.

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- b. Within two weeks of the original notification, the Contractor, Subcontractor vendor and manufacturer's representative shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals, training, warranty, etc.
- c. The proposed solution shall significantly exceed the specified requirements of the original installation and meet or exceed the performance identified in the Contract Documents.
- d. The Owner will determine whether a replacement of all identical units or a repair is acceptable.
- e. Two (2) examples of the proposed solution will be provided by the Contractor or Subcontractor and all parties will be allowed to test and review the performance for up to one week, upon which the Owner will decide whether to accept the proposed solution.
- f. Upon acceptance of the proposed solution by the Owner, the responsible party shall replace or repair all identical units, at their expense and extend the warranty accordingly, if the original equipment warranty had already begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when replacement parts or units can be obtained.

F. Cost(s) of Re-testing System or Equipment due to Manufacturing Defect

1. The cost for the Contractor or Subcontractor to perform re-testing, if they are responsible for providing the defective equipment, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the Owner.
2. The cost associated with the time used by the CxA to direct any re-testing required because of defective equipment, will be back-charged to the Contractor, who may choose to recover costs from the party responsible.

3.9 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- A. The Contractor and Subcontractors shall be responsible for coordinating, scheduling and completing operations and maintenance training for the Owners designated personnel on all systems and equipment to be commissioned.
  1. All training materials (agenda, hand-outs, etc.) shall be submitted to the CxA for review and approval at least three weeks in advance of scheduled training.
  2. Equipment training shall be provided by a factory authorized technical representatives, experienced in training, operation and maintenance procedures for installed systems, subsystems and equipment.
  3. All qualifications and certifications of the individual performing the training shall be submitted to the CxA for review and approval at least two weeks in advance of scheduled training.
  4. Each Subcontractor responsible for training will submit a written training plan to the CxA for review and approval at least three weeks in advance of scheduled training. The plan will include field orientation during installation, classroom instruction and field training after the completion of installation and cover the following elements:
    - a. Equipment (to be included in training).
    - b. Intended audience
    - c. Location of training

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- d. Objectives
  - e. Subjects to be covered (i.e. description, special methods, etc.)
  - f. Duration of training on each subject.
  - g. Instructor for each subject
  - h. Methods of instruction (i.e. classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
  - i. Instructor and qualifications
5. Subcontractors shall provide all qualified personnel, including manufacturer representatives, vendors, technicians, installing personnel, etc. for equipment and system training.
- B. The CxA will oversee the training of Owner personnel for systems to be commissioned.
1. Training rigor: to be established by Owner and CxA.
  2. In addition to these general requirements, the specific training requirements for Owner personnel are specified in Divisions 1 and the specific requirements identified in each Section.
- C. All training shall meet the requirements per the following outline as follows:
1. General familiarization and operating procedures for each of the building's system installations.
  2. Routine maintenance procedures for equipment.
  3. Review of the approved O&M manuals
  4. Specific operating and maintenance procedures for:
    - a. Mechanical systems
    - b. Electrical systems
    - c. Plumbing systems
    - d. Fire protection systems
    - e. Direct digital control system
    - f. Envelope systems
  5. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  6. Inspection procedures.
  7. Schedule for routine cleaning and maintenance.
  8. Repair instructions.
  9. Additional topics as outlined by the owner or CxA at the time of training material review

### 3.10 EXCLUSIONS

- A. The CxA is not responsible for the following: facilitating construction means or methods, regulating job site safety or providing any other unrelated management function.
- B. The CxA is not responsible for providing Design Engineering services.
- C. The CxA is not responsible for providing installation technician services requiring tools or the use of tools to functionally test, adjust or otherwise bring equipment into a fully operational state. The CxA shall observe technicians as they complete testing, and may make minor adjustments, but shall not perform installation or technician services. The Contractor and/or appropriate

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Subcontractor are responsible for providing all installation technician, vendor or manufacturer representative services as needed to meet the CxA's needs.

3.11 TEMPLATES

- A. Contractors are to complete and sign the Certificate of Readiness for each piece of equipment or system to be commissioned.

# CERTIFICATE OF READINESS

---

**Project Name:** \_\_\_\_\_

As the installing and/or responsible contractor for equipment and systems listed below, I hereby certify that \_\_\_\_\_ (company name) has performed the required due diligence and has fully installed, inspected, tested these systems/equipment, for the above listed project. I/We also certify that the said systems are fully operational, and are in conformance with the contract documents and are prepared for final acceptance review by the Commissioning Authority (CxA) as outlined in the project Commissioning specification in Division 1. The signatory shall be the responsible contractor/subcontractor for placing the equipment/system into fully operational service.

By signing this certificate of readiness the contractor/subcontractor hereby acknowledges that:

1. If equipment or systems are found deficient, they will require additional testing efforts by the CxA as well as supporting contractors.
2. By signing this certificate, it is understood that the associated subcontractors (TAB, ATC, etc.) were consulted for compliance prior to signing and said subcontractors also fully acknowledge the equipment/systems full preparedness for final review by the CxA.
3. Where additional testing is required due to deficiencies, all costs associated with the additional testing or re-testing will be the responsibility of the contractor/subcontractor (signatory).

## **Section I** (fill in blanks)

As a representative of \_\_\_\_\_ (company name) I

\_\_\_\_\_ (print name) hereby certify that the

\_\_\_\_\_ (equipment/system) has/have been fully reviewed for

Conformance with the project requirements and the following documents have been provided to the CxA:

**Section II** (initial each line for compliance, or N/A for reports that are not applicable to this system/equipment)

- 1) Equipment start-up reports. \_\_\_\_\_
- 2) Completed Pre-functional Checklists. \_\_\_\_\_
- 3) Flushing, cleaning, and pressure testing reports. \_\_\_\_\_
- 4) Field quality testing reports including but not limited to; NETA, ASTM, NFPA, etc.. \_\_\_\_\_
- 5) Testing, Adjusting, and Balancing (TAB) report. \_\_\_\_\_
- 6) ATC Point-to-point compliance sheet. \_\_\_\_\_

\_\_\_\_\_  
Print name

\_\_\_\_\_  
Company

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

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END OF SECTION 019113

SECTION 019119.43 - EXTERIOR ENCLOSURE COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes building enclosure Cx process requirements for the above- and below-grade systems and assemblies:
  - 1. Horizontal and vertical waterproofing.
  - 2. Opaque walls.
  - 3. Roofs.
  - 4. Openings.
  - 5. Interfaces.
- B. Related Requirements:
  - 1. Section 019113 "General Commissioning Requirements" for general requirements for Cx processes including definitions, Cx team membership, Owner's responsibilities, Contractor's responsibilities, and CxA's responsibilities.

1.2 DEFINITIONS

- A. Building Enclosure: Materials, components, systems, and assemblies intended to provide shelter and environmental separation between interior and exterior, or between two or more environmentally distinct interior spaces in a building or structure. The building enclosure includes, but is not limited to, exterior walls, above and below grade, and roof assemblies.
- B. Cx: Commissioning, as defined in Section 109113 "General Commissioning Requirements."
- C. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- D. First-Installation Mockups: Initial installation of specific enclosure materials, components, systems, and assemblies that are part of Work.
- E. Integrated Exterior Mockups: Integrated mockups of the exterior enclosure erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
- F. Laboratory Mockups: Full-size physical assemblies constructed at testing facility.
- G. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.
- H. Water Penetration: Visible evidence of uncontrolled water penetration on or adjacent to the test specimen in a location not intended to collect and drain water to the building exterior.

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1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For testing agency.
- C. Construction Checklists: Draft Construction Checklists will be created by CxA for Contractor review.
- D. Cx Process Submittals:
  - 1. Shop Drawings: For mockups, including elevations, plans, sections, and full-size details. Show interface conditions, interconnections, and terminations.
  - 2. Testing Program: Developed specifically for Project.
  - 3. Test Reports: Prepared by a qualified testing agency for each test.
  - 4. Record Drawings: As-built drawings of mockups showing changes made during testing.
- E. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For building envelope systems and components to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- B. Build mockups to evaluate constructability and performance, and demonstrate the coordination of trades and sequencing of work necessary to ensure functional and integrated performance of materials, components, systems, assemblies, and interfaces.
  - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 2. Notify Architect and CxA seven days in advance of the dates and times when mockups will be constructed and tested.
- C. Laboratory Mockups: Build at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.
- D. Integrated Exterior Mockups: Build at Project site on site at locations as directed by Architect.

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- E. First Installation Mockups: Prepare each major exterior enclosure system for testing when first installed and before proceeding with construction of additional similar assemblies. If in compliance, Work may remain as part of the completed construction.
  - 1. Wall Mockups: Extend one full structural bay wide by one full story high plus additional height to connect to assemblies below and above. Include a typical wall to interior floor slab connections.
    - a. Minimum Size: 100 sq. ft.
  - 2. Vertical Below-Grade Waterproofing Mockups: Include edge, termination, and penetrations.
  - 3. Building Expansion Joint Mockups: Include starting point at foundation and extend up vertical surfaces, across horizontal waterproofed surfaces and roofs and return to foundation. Include each type of corner, intersection, transition, and termination.
- F. Mockups specified for quality assurance and control in the following sections may be combined with Cx mockups for testing purposes.
  - 1. Section 042000 "Unit Masonry."
  - 2. Section 044200 "Exterior Stone Cladding."
  - 3. Section 072726 "Fluid-Applied Membrane Air Barriers."
  - 4. Section 084413 "Glazed Aluminum Curtain Walls."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

- A. Prepare detailed Construction Checklists for exterior enclosure Cx systems, subsystems, equipment, and components. Complete and submit Construction Checklists.

3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft Construction Checklists. CxA will create required draft Construction Checklists and provide them to Contractor.
- B. Return draft Construction Checklist review comments within 10 days of receipt.
- C. When review comments have been resolved, CxA will provide final Construction Checklists, marked "Approved for Use, (date)."
- D. Use only Construction Checklists, marked "Approved for Use, (date)."

3.3 GENERAL TESTING REQUIREMENTS

- A. If tests cannot be completed because of a deficiency outside the scope of the building enclosure systems, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

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- B. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- C. Coordinate schedule with, and perform Cx activities at the direction of the CxA.

3.4 INTEGRATED EXTERIOR MOCKUP TESTING

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Integrated Exterior Mockup Testing Program: Perform the following tests in the following order:
  - 1. Smoke Testing: ASTM E1186 at a static-air-pressure differential of 1.57 lbf/sq. ft.
  - 2. Opaque Wall Air Infiltration: ASTM E783 at a static-air-pressure differential of 1.57 lbf/sq. ft.
    - a. Maximum air leakage of 0.40 cfm/ft<sup>2</sup>.
  - 3. Window Air Infiltration: ASTM E783 at a static-air-pressure differential of 1.57 lbf/sq. ft.
    - a. Maximum air leakage of 0.40 cfm/ft<sup>2</sup>.
  - 4. Water Penetration under Static Pressure: ASTM E1105 with minimum uniform and cyclic static-air-pressure differential of 6.24 lbf/sq. ft.
    - a. No evidence of water penetration.
  - 5. Water Penetration under Dynamic Pressure: AAMA 501.1 at a test pressure of 6.24 lbf/sq. ft.
    - a. No evidence of water penetration.
  - 6. Pull-off Strength of Adhered Air Barriers: ASTM D4541 as modified by ABAA.
    - a. Minimum 16 lbf/sq. in. adhesion to substrate.

3.5 FIRST-INSTALLATION MOCKUP TESTING

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Wall Mockups: Perform the following tests in the following order:
  - 1. Smoke Testing: ASTM E1186 at a static-air-pressure differential of 1.57 lbf/sq. ft.
  - 2. Opaque Wall Air Infiltration: ASTM E783 at a static-air-pressure differential of 1.57 lbf/sq. ft.
    - a. Maximum air leakage of 0.40 cfm/ft<sup>2</sup>.
  - 3. Window Air Infiltration: ASTM E783 at a static-air-pressure differential of 1.57 lbf/sq. ft.

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- a. Maximum air leakage of 0.40 cfm/ft<sup>2</sup>.
  - 4. Water Penetration under Static Pressure: ASTM E1105 with minimum uniform and cyclic static-air-pressure differential of 6.24 lbf/sq. ft.
    - a. No evidence of water penetration.
  - 5. Water Penetration under Dynamic Pressure: AAMA 501.1 at a test pressure of 6.24 lbf/sq. ft.
    - a. No evidence of water penetration.
  - 6. Pull-off Strength of Adhered Air Barriers: ASTM D4541.
    - a. 16 lbf/sq. in.
  - C. Vertical Below-Grade Waterproofing Mockups: Perform the following tests in the following order:
    - 1. Water Penetration: ASTM E1105 without air-pressure differential
      - a. No evidence of water penetration.
    - 2. Water-Spray Test: AAMA 501.2.
      - a. No evidence of water penetration.
  - D. Building Expansion Joint Mockups: Perform the following tests in the following order:
    - 1. Water Penetration under Static Pressure: ASTM E1105 with minimum uniform and cyclic static-air-pressure differential specified for laboratory testing, but not less than 6.24 lbf/sq. ft.
      - a. No evidence of water penetration.
    - 2. Water-Spray Test: AAMA 501.2.
      - a. No evidence of water penetration.
- 3.6 BUILDING ENCLOSURE TESTING
- A. Building Enclosure Testing: Perform testing before installation of interior finishes unless otherwise indicated.
  - B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - C. Building Enclosure Testing: Perform the following tests in the following order:
    - 1. Whole Building Air Tightness Using an Orifice Blower Door: ASTM E1827.
      - a. Maximum Air Leakage Rate: 0.15 cfm/sq. ft.

END OF SECTION



## SECTION 024119 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.
2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 017300 "Execution" for cutting and patching procedures.
4. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.
5. Section 330500 "Common Work Results for Utilities" for removal of site utility systems piping, equipment, and components.

#### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed.

#### 1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

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1.4 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
  - 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure.
  - 3. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  - 5. Review areas where existing construction is to remain and requires protection.
  - 6. Review and finalize protection requirements.
  - 7. Review procedures for noise control and dust control.
  - 8. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Statements: For refrigerant recovery technician.
- C. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
  - 2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
  - 4. Use of elevator and stairs.
  - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed in accordance with EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Inventory: Submit a list of items that have been removed and salvaged.

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1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Licensed in the State of Maine and certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

- A. Owner will not occupy portions of building immediately adjacent to selective demolition area.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials:
  - 1. Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
    - a. Hazardous material remediation is specified in Section **<Insert Section number>** “**<Insert Section title>**.”
- E. On-site sale of removed items or materials is not permitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.
- C. Sustainable Design Requirements for Building Reuse:
  - 1. Maintain the existing building structure, envelope, and interior nonstructural elements of a historic building or contributing building in a historic district. Do not demolish such existing construction beyond indicated limits.
  - 2. Maintain the existing building structure, envelope, and interior nonstructural elements of an abandoned or blighted building. Do not demolish such existing construction beyond indicated limits.
  - 3. Maintain the existing building facade where indicated to remain. Do not demolish such existing construction beyond indicated limits.
  - 4. Maintain the existing building structural systems where indicated to remain. Do not demolish such existing construction beyond indicated limits.
  - 5. Maintain the existing interior ceilings, interior partitions, and/or demountable walls

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where indicated to remain. Do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION (Not Applicable)

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video. Comply with Section 013233 "Photographic Documentation."
  - 1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
  - 2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

- A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
  - 1. Strengthen or add new supports when required during progress of selective demolition.
- B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable,

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protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

- D. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND BUILDING SYSTEMS

- A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.
1. Arrange to shut off utilities with utility companies.
  2. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
  3. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  5. Maintain fire watch during and for at least four hours after flame-cutting operations.
  6. Maintain adequate ventilation when using cutting torches.
  7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

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8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
  2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

### 3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete:
1. Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
  2. Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

### 3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them in accordance with Section 017419 "Construction Waste Management and Disposal."
1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

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3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Form-facing material for cast-in-place concrete.
  - 2. Form liners.
- B. Related Requirements:
  - 1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review the following:
    - a. Inspection and testing and inspecting agency procedures for field quality control.
    - b. Construction, movement, contraction, and isolation joints
    - c. Forms and form-removal limitations.
    - d. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each of the following:



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1. Form liners.
2. Form ties.
3. Waterstops.

C. Sustainable Design Submittals:

1. **Product Data:** For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For testing and inspection agency.
- C. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC308.
- D. Field quality-control reports.
- E. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Form Liners: Store form liners under cover to protect from sunlight.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:

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1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
  - a. Plywood, metal, or other approved panel materials.
  - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - 1) APA HDO (high-density overlay).
    - 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
    - 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
    - 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

## 2.3 WATERSTOPS

- A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Williams Products, Inc.
  2. Profile: Flat dumbbell with center bulb.
  3. Dimensions: 4 inches by 3/16 inch thick; nontapered.

## 2.4 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
  1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
  2. Form release agent for form liners shall be acceptable to form liner manufacturer.

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- F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
  - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
  - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
  - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
  - 1. Minimize joints.
  - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
  - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
  - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
  - 1. Provide and secure units to support screed strips
  - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

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1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
  2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
  2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
  2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  3. Place joints perpendicular to main reinforcement.
  4. Space vertical joints in walls as indicated on Drawings.
    - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
  2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

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2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

### 3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
  1. Install in longest lengths practicable.
  2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
  3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
  4. Secure waterstops in correct position at 12 inches on center.
  5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
    - a. Miter corners, intersections, and directional changes in waterstops.
    - b. Align center bulbs.
  6. Clean waterstops immediately prior to placement of concrete.
  7. Support and protect exposed waterstops during progress of the Work.

### 3.4 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
- B. Clean and repair surfaces of forms to be reused in the Work.
  1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
  2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
  1. Align and secure joints to avoid offsets.
  2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

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B. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

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SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:
  - a. Testing and inspecting agency procedures for field quality control.
  - b. Construction contraction and isolation joints.
  - c. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For the following:

1. Each type of steel reinforcement.
2. Epoxy repair coating.
3. Bar supports.

C. Sustainable Design Submittals:

1. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
2. Manufacturer Inventory: Provide manufacturer's ingredient inventory.

D. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

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- E. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
  - 1. Location of construction joints is subject to approval of Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
  - 2. Dual-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
- C. Material Test Reports: For the following, from a qualified testing agency:
  - 1. Steel Reinforcement:
    - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
  - 2. Mechanical splice couplers.
- D. Field quality-control reports.
- E. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage and to avoid damaging coatings on steel reinforcement.
  - 1. Store reinforcement to avoid contact with earth.
  - 2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.



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1. Regional Materials: Manufacture steel within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- C. Galvanized Reinforcing Bars:
  1. Steel Bars: ASTM A615/A615M, Grade 60, deformed bars.
  2. Zinc Coating: ASTM A767/A767M, Class I zinc coated after fabrication and bending.
- D. Epoxy-Coated Reinforcing Bars:
  1. Steel Bars: ASTM A615/A615M, Grade 60, deformed bars.
  2. Epoxy Coating: ASTM A775/A775M with less than 2 percent damaged coating in each 12-inch bar length.
- E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- F. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.
- G. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A coated, Type 1, plain steel.

## 2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, ASTM A775/A775M epoxy coated.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
  1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports.
    - b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
    - c. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
- D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
  1. Finish: Plain.

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- E. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.

## 2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection of In-Place Conditions:
  - 1. Do not cut or puncture vapor retarder.
  - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

### 3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
  - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
  - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
  - 2. Stagger splices in accordance with ACI 318.
- G. Install welded-wire reinforcement in longest practicable lengths.
  - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
    - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.

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2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
  3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
  4. Lace overlaps with wire.
- H. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.
- I. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material in accordance with ASTM A780/A780M.

### 3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement.
  2. Continue reinforcement across construction joints unless otherwise indicated.
  3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

### 3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
1. Steel-reinforcement placement.

END OF SECTION

## SECTION 033000 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Concrete standards.
2. Concrete materials.
3. Concrete mixture materials.
4. Concrete mixing.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
4. Section 316329 "Micropiles" for cement grout mix design.

#### 1.2 DEFINITIONS

A. Cementitious Materials: Portland cement or blended hydraulic cement alone or in combination with one or more of the following:

1. Fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cementitious Materials (w/cm) Ratio: The ratio by weight of mixing water to cementitious materials.

#### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
  - a. Contractor's superintendent.
  - b. Independent testing agency responsible for inspections and acceptance testing of concrete at Project site.
  - c. Ready-mix concrete manufacturer.
  - d. Concrete Subcontractor.
2. Review the following:

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- a. Inspection and testing and inspecting agency procedures for field quality control.
- b. Construction joints, control joints, isolation joints, and joint-filler strips.
- c. Semirigid joint fillers.
- d. Vapor-retarder installation.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold- and hot-weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Methods for achieving specified floor and slab flatness and levelness.
- k. Floor and slab flatness and levelness measurements.
- l. Concrete repair procedures.
- m. Concrete protection.
- n. Initial curing of standard-cured and field curing of field-cured test cylinders (ASTM C31/C31M.)
- o. Protection of field cured field test cylinders.
- p. Distribution of test reports.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data:
  1. Portland cement.
  2. Blended hydraulic.
  3. Fly ash.
  4. Slag cement.
  5. Silica fume.
  6. Natural or other pozzolans.
  7. Aggregates.
  8. Admixtures:
    - a. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.
  9. Vapor retarders.
  10. Floor and slab treatments.
  11. Liquid floor treatments.
  12. Curing materials.
  13. Joint fillers.
  14. Repair materials.
- C. Sustainable Design Submittals:
  1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
  2. Regional Materials.
  3. Laboratory Test Reports: For liquid floor treatments and curing and sealing compounds, indicating compliance with requirements for low-emitting materials.

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4. Health Product Declaration (HPD): Provide documentation confirming product compliance with one of the following:
  - a. Inventory or HPD to at least 0.01 percent by weight with no GreenScreen LT-1 or GHS Category 1 hazards.
  - b. Inventory or HPD to at least 0.01 percent by weight, with at least 75 percent assessed using GreenScreen Benchmark assessment.
  - c. Third-party-verified Declare product label, designated "Red List Free."
  - d. Material Health Certificate or Cradle to Cradle certification with minimum Bronze level of Material Health.

D. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Compressive strength at 28 days or other age as specified.
3. Compressive strength required at stages of construction.
4. Durability exposure classes for Exposure Categories F, S, W, and C.
5. Maximum w/cm ratio.
6. Slump or slump flow limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Intended placement method.
10. Submit adjustments to design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant changes.

E. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - a. Location of construction joints is subject to approval of the Architect.

F. Concrete Schedule: For each location of each class of concrete indicated in "Concrete Mixture Class Types" Article, including the following:

1. Concrete class designation.
2. Location within Project.
3. Exposure class designation.
4. Formed surface finish designation and final finish.
5. Final finish for floors.
6. Floor treatment, if any.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For the following:
  1. Installer: Include copies of applicable ACI certificates.

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2. Testing Agency: Include documentation indicating compliance with ASTM E329 or ASTM C1077 and copies of applicable ACI certificates for testing technicians or ACI Concrete Construction Special Inspector - MH, ASCC.

C. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

D. Material Test Reports: For the following:

1. Portland cement.
2. Blended hydraulic cement.
3. Fly ash.
4. Slag cement.
5. Aggregates.
6. Admixtures.

E. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

F. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC's Acceptance Criteria AC380.

G. Preconstruction Test Reports: For each mix design.

H. Field quality-control reports.

I. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

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- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
  - 1. Manufacturer's production facilities and delivery vehicles certified in accordance with NRMCA's certification requirements or equivalent approval by a State DOT.
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing that performs duties on behalf of the Architect/Engineer.
  - 1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Level 1. Testing agency laboratory supervisor tests to be an ACI-certified Concrete Laboratory Testing Technician, Level 2.
- D. Field Quality-Control Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
  - 1. Personnel conducting field tests on plastic concrete properties are to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with policies from ACI CPP 610.1 or an equivalent certification program.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 as follows:
  - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 2. When air temperature has fallen to, or is expected to fall below 40 deg F during the protection period, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  - 3. Do not use frozen materials or materials containing ice or snow.
  - 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
  - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
  - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.



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PART 2 - PRODUCTS

2.1 CONCRETE STANDARDS

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Regional Materials: Verify concrete is manufactured within 500 miles of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Regional Materials: Verify concrete is manufactured within 500 miles of Project site.
- C. Source Limitations:
1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
  2. Obtain each type of admixture from single source from single manufacturer.
- D. Cementitious Materials:
1. Portland Cement: ASTM C150/C150M, Type I, Type II, or Type III, gray.
  2. Blended Hydraulic Cement: ASTM C595/C595M, Type IP, Portland-pozzolan, Type IL, portland-limestone, or Type IT, blended cement.
  3. Pozzolans: ASTM C618, Class C, F, or N.
  4. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
  5. Silica Fume: ASTM C1240.
- E. Normal-Weight Aggregates:
1. Coarse Aggregate: ASTM C33/C33M, Class 3S
  2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  3. Fine Aggregate: ASTM C33/C33M.
  4. Alkali-Silica Reaction: Comply with one of the following for each aggregate used:
    - a. Expansion Result of Aggregate: Not more than 0.04 percent at one year when tested in accordance with ASTM C1293.
    - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567. Do not use this option with fly ash with an alkali content greater than 4.0 percent. Submit supporting data for each aggregate showing expansion in excess of 0.10 percent when tested in accordance with ASTM C1260.
    - c. Alkali Content in Concrete: Not to exceed 4 lb./cu. yd. for aggregate with expansion greater than or equal to 0.04 percent and less than 0.12 percent or 3 lb./cu. yd. for aggregate with expansion greater than or equal to 0.12 percent and less than 0.24 percent. Test aggregate reactivity in accordance with ASTM C1293. Calculate alkali content of concrete in accordance with ACI 301. Do not use this option with natural pozzolan or fly ash that has a calcium oxide content greater

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than 18 percent or an alkali content greater than 4.0 percent; or for an aggregate with expansion at one year greater than or equal to 0.24 percent when tested in accordance with ASTM C1293.

- F. Lightweight Aggregate: ASTM C330/C330M, 3/4-inch nominal maximum aggregate size.

## 2.3 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260/C260M.

- B. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Admixtures with special properties, with documentation of claimed performance enhancement, ASTM C494/C494M, Type S.
7. Set-Accelerating Corrosion-Inhibiting Admixture: ASTM C1582/C1582M.

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 1) Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
- 2) GCP Applied Technologies Inc.
- 3) MAPEI Corporation.
- 4) Master Builders Solutions, brand of MBCC Group, a Sika company.
- 5) Sika Corporation.

8. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline or colloidal silica admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 1) AQUAFIN, Inc.
- 2) AVECS LLC.
- 3) Barrier One, Inc.
- 4) Bone Dry Products, Inc.
- 5) ISE Logik Industries, Inc.
- 6) Kryton International, Inc.
- 7) Master Builders Solutions, brand of MBCC Group, a Sika company.
- 8) Penetron USA, Inc.
- 9) Xypex Chemical Corporation.

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- b. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRD C48 at a hydraulic pressure of 200 psi for 14 days.
- 9. Moisture-Vapor-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, moisture-vapor-reducing, capable of reducing water absorption in and moisture-vapor emission from concrete (MVRA).
  - a. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - 1) AQUAFIN, Inc.
    - 2) AVECS LLC.
    - 3) Barrier One, Inc.
    - 4) Bone Dry Products, Inc.
    - 5) Concure Products Inc.
    - 6) ISE Logik Industries, Inc.
    - 7) Kryton International, Inc.
    - 8) Master Builders Solutions, brand of MBCC Group, a Sika company.
    - 9) Moxie International.
    - 10) Xypex Chemical Corporation.
- C. Mixing Water for Concrete Mixtures and Water Used to Make Ice: ASTM C1602/C1602M. Include documentation of compliance with limits for alkalis, sulfates, chlorides, or solids content of mixing water from Table 2 in ASTM C1602/C1602M.

## 2.4 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A, except with maximum water-vapor permeance of not less than 15 mils thick. Include manufacturer's recommended thickness and adhesive or pressure-sensitive tape.
  - 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Barrier-Bac; Inteplast Group.
    - b. Foxfire Enterprises, Inc.
    - c. ISI Building Products.
    - d. Poly-America, L.P.
    - e. R&D Workshop.
    - f. Reef Industries, Inc.
    - g. Stego Industries, LLC.
    - h. Tex-Trude.
    - i. Viaflex.
    - j. W. R. Meadows, Inc.

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2.5 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Bone Dry Products, Inc.
  - b. ChemMasters, Inc.
  - c. ChemTec International.
  - d. Concrete Sealers USA.
  - e. Curecrete Distribution Inc.
  - f. Dayton Superior Corporation.
  - g. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
  - h. HTS Chemical; Hi-Tech Systems.
  - i. Kaufman Products, Inc.
  - j. Laticrete International, Inc.
  - k. MAPEI Corporation.
  - l. Master Builders Solutions, brand of MBCC Group, a Sika company.
  - m. NewLook International, Inc.
  - n. Nox-Crete Products Group.
  - o. PROSOCO, Inc.
  - p. Penetron USA, Inc.
  - q. SINAK.
  - r. Solomon Colors Inc.
  - s. SpecChem, LLC.
  - t. Specialty Products Group.
  - u. US SPEC, Division of US MIX Company.
  - v. V-Seal Concrete Sealers & Specialty Coatings.
  - w. Vexcon Chemicals Inc.
  - x. W. R. Meadows, Inc.
2. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Bon Tool Co.
  - b. Brickform; a division of Solomon Colors.
  - c. ChemMasters, Inc.

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- d. [Dayton Superior Corporation.](#)
  - e. [Euclid Chemical Company \(The\); a subsidiary of RPM International, Inc.](#)
  - f. [Kaufman Products, Inc.](#)
  - g. [Lambert Corporation.](#)
  - h. [Laticrete International, Inc.](#)
  - i. MAPEI Corporation.
  - j. Master Builders Solutions, brand of MBCC Group, a Sika company.
  - k. [Metalcrete Industries.](#)
  - l. [Nox-Crete Products Group.](#)
  - m. SINAK.
  - n. [Sika Corporation.](#)
  - o. [SpecChem, LLC.](#)
  - p. [TK Products Construction Coatings, a Fenix Group SPC Company.](#)
  - q. [Vexcon Chemicals Inc.](#)
  - r. [W. R. Meadows, Inc.](#)
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
1. Color:
    - a. Ambient Temperature Below 50 deg F (10 deg C): Black.
    - b. Ambient Temperature between 50 and 85 deg F (10 and 29 deg C): Any color.
    - c. Ambient Temperature Above 85 deg F (29 deg C): White.
- D. Curing Paper: 8 ft. wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands).
- E. Water: Potable water that does not cause staining of the surface.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. [Anti-Hydro International, Inc.](#)
    - b. [ChemMasters, Inc.](#)
    - c. [Dayton Superior Corporation.](#)
    - d. [Euclid Chemical Company \(The\); a subsidiary of RPM International, Inc.](#)
    - e. [Kaufman Products, Inc.](#)
    - f. [Lambert Corporation.](#)

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- g. [Laticrete International, Inc.](#)
- h. [MAPEI Corporation.](#)
- i. [Nox-Crete Products Group.](#)
- j. [SpecChem, LLC.](#)
- k. [TK Products Construction Coatings, a Fenix Group SPC Company.](#)
- l. [Vexcon Chemicals Inc.](#)
- m. [W. R. Meadows, Inc.](#)

2.7 ACCESSORIES

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
  - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

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2.9 CONCRETE MIXTURE MATERIALS

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
  - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland or hydraulic cement in concrete assigned to Exposure Class F3 as follows:
  - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
  - 2. Slag Cement: 50 percent by mass.
  - 3. Silica Fume: 10 percent by mass.
  - 4. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
  - 5. Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
  - 1. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
  - 2. Use permeability-reducing admixture in concrete mixtures where indicated.

2.10 CONCRETE MIXTURE CLASS TYPES

- A. Class A: Normal-weight concrete used for footings and piers.
  - 1. Exposure Class: ACI 318, Class F0, Class S0, Class S3, Class W0, Class C0.
  - 2. Minimum Compressive Strength: 3000 psi at 28 days.
  - 3. Maximum w/cm Ratio: 0.50 Insert number.
  - 4. Slump Limit: 5 inches, plus or minus 1-1/2 inches for concrete.
  - 5. Air Content:
    - a. Exposure Class F0: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
  - 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cementitious materials.
- B. Class B: Normal weight used for foundation walls.
  - 1. Exposure Class: ACI 318, Class F3, Class S1, Class W0.
  - 2. Minimum Compressive Strength: 5000 psi at 28 days.
  - 3. Maximum Water Cement Ratio : 0.40.
  - 4. Slump Limit: 4 inches, plus or minus 1 inch for concrete.
  - 5. Limit water-soluble, chloride ion content to hardened concrete to 0.15 percent by weight of cement.
- C. Class C: Normal-weight concrete used for interior slabs-on-ground, pile caps, and grade beam.

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1. Exposure Class: ACI 318, Class F0, Class S0, Class S3, Class W0, Class C0, Class C1, Class C2.
  2. Minimum Compressive Strength: 4000 psi at 28 days.
  3. Maximum w/cm Ratio : 0.45.
  4. Slump Limit: 5 inches, plus or minus 1.5 inches for concrete.
  5. Air Content:
    - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
  6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Class D: Structural lightweight concrete used for interior suspended slabs.
1. Exposure Class: ACI 318, Class F0, Class S1, Class W0.
  2. Minimum Compressive Strength: 4000 psi at 28 days.
  3. Equilibrium Density: 115 lb/cu. ft., plus or minus 4 lb/cu. ft. in accordance with ASTM C567/C567M.
  4. Slump Limit: 5 inches, plus or minus 1.5 inches for concrete.
  5. Air Content:
    - a. Total air content must not to exceed 3 percent for concrete used in trowel-finished floors.
  6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Class E: Normal-weight concrete used for concrete toppings.
1. Exposure Class: ACI 318, Class F0, Class F3, Class S1.
  2. Minimum Compressive Strength: 4000 psi at 28 days.
  3. Maximum w/cm Ratio: 0.45.
  4. Slump Limit: 5 inches, plus or minus 1.5 inches for concrete.
  5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
    - a. Total air content must not to exceed 3 percent for concrete used in trowel-finished floors.
- F. Class F: Normal-weight concrete used for exterior retaining walls.
1. Exposure Class: ACI 318, Class F3, Class S1, Class W0.
  2. Minimum Compressive Strength: 5000 psi at 28 days.
  3. Maximum w/cm Ratio: 0.40.
  4. Slump Limit: 4 inches, plus or minus 1 inch for concrete.
  5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.



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2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish delivery ticket.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
  - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
  - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
  - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
  - 1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
  - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
  - 1. Daily access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
  - 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 TOLERANCES

- A. Comply with ACI 117.

### 3.4 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
  - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install reglets to receive waterproofing and through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

### 3.5 INSTALLATION OF VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
  - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
  - 2. Face laps away from exposed direction of concrete pour.
  - 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
  - 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
  - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
  - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
  - 7. Protect vapor retarder during placement of reinforcement and concrete.
    - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides and sealing to vapor retarder.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

### 3.6 INSTALLATION OF CAST-IN-PLACE CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
  - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
  - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Water addition in transit or at the Project site must be in accordance with ASTM C94/C94M and must not exceed the permitted amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

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1. If a section cannot be placed continuously, provide construction joints as indicated.
  2. Deposit concrete to avoid segregation.
  3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
  2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  3. Maintain reinforcement in position on chairs during concrete placement.
  4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  5. Level concrete, cut high areas, and fill low areas.
  6. Slope surfaces uniformly to drains where required.
  7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  8. Do not further disturb slab surfaces before starting finishing operations.

### 3.7 INSTALLATION OF JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
  2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
  3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.

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7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
  2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

### 3.8 APPLICATION OF FINISHING FLOORS AND SLABS

A. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish and.

B. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface. Use of an approved finishing aid is acceptable.
5. Do not apply troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

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7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

- a. Slabs on Ground:

- 1) Specified overall values of flatness,  $F_F$  35; and of levelness,  $F_L$  25; with minimum local values of flatness,  $F_F$  24; and of levelness,  $F_L$  17.

- C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with a fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

### 3.9 APPLICATION OF FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
  - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
  - b. Remove projections larger than 1 inch.
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117, Class D.
  - e. Apply to concrete surfaces for metal lap pan deck formed surfaces and those surfaces that are buried or covered with subsequent installed surfaces.
2. ACI 301 (ACI 301M) Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
  - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/4 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117, Class B.
  - e. Locations: Apply to concrete surfaces exposed to public view,.

### 3.10 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling in:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to match color and texture with in-place construction exposed to view.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

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- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
  - 3. Minimum Compressive Strength: 4000 psi at 28 days.
  - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  - 6. Prior to pouring concrete, place and secure anchorage devices.
    - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - b. Cast anchor-bolt insert into bases.
    - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
  - 1. Cast-in inserts and accessories, as shown on Drawings.
  - 2. Screed, tamp, and trowel finish concrete surfaces.

### 3.11 APPLICATION OF CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
  - 1. Comply with ACI 301 for cold weather protection during curing.
  - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
  - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305R, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
  - 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
  - 2. If forms remain during curing period, moist cure after loosening forms.
  - 3. If removing forms before end of curing period, continue curing for remainder of curing period as follows:
    - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    - b. Continuous Sprinkling: Maintain concrete surface continuously wet.

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- c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
  - d. Water-Retention Sheetting Materials: Cover exposed concrete surfaces with sheetting material, taping, or lapping seams.
  - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
    - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
    - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
- 1. Begin curing after finishing concrete.
  - 2. Interior Concrete Floors:
    - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
      - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
        - a) Lap edges and ends of absorptive cover not less than 12 inches.
        - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
      - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
        - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
        - b) Cure for not less than seven days.
      - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following not in cold weather:
        - a) Water.
        - b) Continuous water-fog spray.
    - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
      - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
        - a) Lap edges and ends of absorptive cover not less than 12 inches.

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- b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - b) Cure for not less than seven days.
  - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- d. Floors To Receive Curing Compound:
  - 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
  - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
  - 3) Maintain continuity of coating, and repair damage during curing period.
  - 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
- e. Floors To Receive Curing and Sealing Compound:
  - 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.



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- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
  1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Do not apply to concrete that is less than seven days old.
  3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
  4. Rinse with water; remove excess material until surface is dry.
  5. Apply a second coat in a similar manner if surface has received a float finish or abrasive surface preparation.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 INSTALLATION OF JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
  1. Defer joint filling until concrete has aged at least one month(s).
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 INSTALLATION OF CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
  1. Repair and patch defective areas when approved by Architect.
  2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

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- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks in excess of 0.01 inch spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets, fins and other projections on the surface exceeding surface finish limits, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
    - a. Limit cut depth to 3/4 inch.
    - b. Make edges of cuts perpendicular to concrete surface.
    - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    - d. Fill and compact with patching mortar before bonding agent has dried.
    - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
    - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    - b. Compact mortar in place and match surrounding surface.
  3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance, as determined by Architect.
- D. Repairing Unformed Surfaces:
1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
    - a. Correct low and high areas.
    - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width.
  3. After concrete has cured at least 14 days, correct high areas by grinding.
  4. Correct localized low areas during, or immediately after, completing surface-finishing operations by adding patching mortar.
    - a. Finish repaired areas to blend into adjacent concrete.
  5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
    - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    - b. Feather edges to match adjacent floor elevations.
  6. Correct other low areas scheduled to remain exposed with repair topping.

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- a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
  - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
  - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
  - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
  - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
  - d. Place, compact, and finish to blend with adjacent finished concrete.
  - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
  - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
  - b. Dampen cleaned concrete surfaces and apply bonding agent.
  - c. Place patching mortar before bonding agent has dried.
  - d. Compact patching mortar and finish to match adjacent concrete.
  - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
  1. Testing agency to be responsible for providing curing facility for initial curing of strength test specimens on-site and verifying that test specimens are cured in accordance with standard curing requirements in ASTM C31/C31M.
  2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

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- a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
    - 1) Project name.
    - 2) Name of testing agency.
    - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
    - 4) Name of concrete manufacturer.
    - 5) Date and time of inspection, sampling, and field testing.
    - 6) Date and time of concrete placement.
    - 7) Location in Work of concrete represented by samples.
    - 8) Date and time sample was obtained.
    - 9) Truck and batch ticket numbers.
    - 10) Design compressive strength at 28 days.
    - 11) Concrete mixture designation, proportions, and materials.
    - 12) Field test results of fresh concrete, including slump or slump flow, air content, temperature and density.
    - 13) Information on storage and curing of samples at the Project site, including curing method and maximum and minimum temperatures during initial curing period.
    - 14) Type of fracture and compressive break strengths at seven days and 28 days.
  4. Provide a space and source of power or other resources for curing and access to test specimens by the testing agency.
- C. Delivery Tickets: comply with ASTM C94/C94M.
- D. Inspections:
1. Headed bolts and studs.
  2. Verification of use of required design mixture.
  3. Concrete placement, including conveying and depositing.
  4. Curing procedures and maintenance of curing temperature.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M:
    - a. One test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests as needed.

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3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.
  - a. One test for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M:
  - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample when strength test specimens are cast.
5. Unit Weight: ASTM C138/C138M density of fresh structural lightweight concrete.
  - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture. The fresh density should be consistent with that associated with the equilibrium density within a tolerance of plus or minus 4 lb/ft.<sup>3</sup>.
6. Compression Test Specimens: ASTM C31/C31M:
  - a. Cast and standard cure two sets of four 6 inches by 12-inches or 4-inch by 8-inch cylindrical specimens for each composite sample.
  - b. Cast, and field cure two sets of standard cylindrical specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39/C39M.
  - a. Test one set of two standard cured specimens at seven days and one set of two specimens at 28 days.
  - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
  - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests:
  - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

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- b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
  - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.7.6.3.
- 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

- A. Protect concrete surfaces as follows:
  - 1. Protect from petroleum stains.
  - 2. Diaper hydraulic equipment used over concrete surfaces.
  - 3. Prohibit vehicles from interior concrete slabs.
  - 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
  - 5. Prohibit placement of steel items on concrete surfaces.
  - 6. Prohibit use of acids or acidic detergents over concrete surfaces.
  - 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
  - 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using floor slab protective covering.

END OF SECTION

## SECTION 040111 - MASONRY CLEANING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete masonry cleaning as indicated on the Drawings, and as specified herein, including, but not limited to, the following:
  - 1. Install protection for all wood and metal elements and for any windows to remain in place during construction.
  - 2. Remove general soiling and staining from 100% of all masonry surfaces, including inner courtyard walls, using specified method for specified chemical and detergent cleaners and pressurized water rinsing.
  - 3. Remove localized metallic stains from all masonry using specified chemical stain removers and pressurized water rinsing. Poulticing with approved chemical stain removers may be necessary to remove heavy staining.
  - 4. Remove localized dripped mortar and paint caused by previous repointing and repairs from all masonry surfaces using mechanical scraping or approved chemical strippers and water rinsing.
  - 5. All masonry cleaning shall be completed prior to repointing and all other exterior restoration work.
- B. Intent: It is the specific intent of this Section to provide for removal of stains from masonry surfaces in order to produce uniformly clean surfaces without blotches, streaks, runs, overly cleaned areas, or any other kind of spotty or uneven appearance and without damaging or deteriorating underlying materials. All work required to accomplish this intent shall be included. Contractor shall correct damage to existing masonry caused by masonry cleaning work to satisfaction of the Owner.
- C. Related Sections include the following:
  - 1. Restoration Mortars - Section 040112.
  - 2. Masonry Repointing – Section 040115.
  - 3. Brick Masonry Restoration - Section 040116.

#### 1.3 QUALITY ASSURANCE

- A. Masonry Cleaning Specialist: Contractor that performs masonry cleaning work shall be regularly engaged in cleaning masonry on historic buildings. Contractor shall demonstrate to Owner's satisfaction that, within previous five (5) years, he has successfully performed and completed in a timely manner at least three (3) projects similar in scope and type to required work involving buildings designated as Landmarks by local governmental authorities; or

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buildings listed on the National Register of Historic Places or on a State Register of Historic Places or pre-qualifications acceptable to the Maine State Historical Preservation Office.

1. Subcontractors: Subcontractors are bound by same requirements as Contractor. No subcontractors shall be employed unless approved in writing by Architect.
  2. Foreman: Masonry cleaning shall be directly supervised by a full-time foreman with experience equal to or greater than that required of Masonry Cleaning Specialist. Foreman shall be on site daily for duration of work of this Section. Same foreman shall remain on project throughout work unless his performance is deemed unacceptable.
  3. Mechanics: Masonry cleaning shall be carried out by a steady crew of skilled mechanics who are thoroughly experienced with materials and methods specified, have a minimum of three (3) years experience with work on historic buildings similar to that required by this Section, and are familiar with design requirements. Contractor shall certify that all mechanics employed for work of this Section fully understand project requirements. In acceptance or rejection of work of this Section, no allowance will be made for workers' incompetence or lack of skill.
- B. The work of all masonry sections shall comply with the United States Department of the Interior *Secretary of the Interior Standards for Rehabilitation of Historic Buildings*.
- C. Alternate Cleaning Methods: If Contractor proposes use of cleaning procedures and products other than those specified and Architect gives preliminary approval following required submittals, Contractor shall create quality control panels demonstrating ability of proposed products and procedures to produce specified cleaning results and for comparison with specified quality control panels. No alternate method shall be permitted until it has been approved by Architect.
- D. Daily Log: Contractor shall keep onsite and available for inspection a daily log describing masonry cleaning operations. Log shall record temperature at beginning and ending of work, weather conditions, whether masonry was wet or dry prior to beginning work, personnel on site, areas cleaned and procedures used, areas inspected and approved, and other relevant information.
- E. Observation and Inspection of Ongoing and Completed Work: Contractor shall provide Architect and Owner's Representative access for observation and inspection of ongoing work and for inspection for approval of completed work.
- F. Instruments for Measuring Temperature: Maintain accurate instruments for measuring temperature at project site to allow assessment of conditions at various locations on building during masonry cleaning work.
1. Measure temperature before beginning and during progress of work of this Section as required to ensure compliance with specified conditions and manufacturer's recommendations for masonry cleaning.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.



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- B. General: Submit each item in this Article in compliance with the Conditions of the Contract and Division 1 specification sections. Revise and resubmit each item as required to obtain approval of Architect.
- C. Qualification Data: Qualification data for firm and personnel specified in "Quality Assurance" Article that demonstrates that both firm and personnel have capabilities and experience complying with requirements specified. For firm and foreman, provide a list of at least three (3) completed projects within the New England region similar in size and scope to work required on this project. For each project list project name, address, restoration consultant, conservator, scope of contractor's work, and other relevant information. This information shall be submitted with the offer.
- D. Program of Work: Written program for restoration work specified in this Section.
  - 1. Prior to any cleaning work on site, submit program for proposed cleaning of masonry.
    - a. Protection: Detailed description, including drawings and diagrams, of proposed materials and methods of protection for preventing harm, damage, or deterioration caused by work of this Section to all persons (whether involved in the Work or not), building elements, materials, and finishes, surrounding landscape and site, and the environment (including air and water).
    - b. Alternate Cleaning Methods and Materials: Contractor proposed alternate methods and materials to those specified for any phase of masonry cleaning. Provide evidence of successful use on comparable projects and demonstrate effectiveness for use on this project.
- E. Product Literature: Manufacturer's published technical data for each product to be used in work of this Section including recommendations for application and use. Include test reports and certificates verifying that product complies with specified requirements. Include Material Safety Data Sheets (MSDS) for each cleaning product and for each other chemical product proposed for use in work of this Section.
- F. Schedule of Masonry Cleaning: Prior to commencing cleaning operations, submit a complete detailed schedule for specified quality control panels and for completion of masonry cleaning.
- G. Waste Disposal Program: Prior to commencing cleaning operations, submit a written description of proposed materials and methods for collection, treatment, and disposal of wastes resulting from cleaning operations.
- H. Daily Log: Submit copy of daily log to Architect each week.
- I. Quality Control Panels: Prepare quality control panels as described in Article "Quality Control Panels," below. Cleaning may not proceed until quality control panels have been approved in writing by Architect or authorized Owner's Representative.

1.5 QUALITY CONTROL PANELS

- A. General: Provide quality control panels to establish the standard for each type of masonry cleaning work in compliance with following requirements. Testing: Cleaning tests shall be performed to determine proper cleaning procedures, chemicals, chemical dilutions and dwell

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time. Following approval by the Architect or authorized Owner's Representative, Quality Control Panels will be prepared based on this testing.

1. For this project, the control panels shall consist of protection system and brick designated for cleaning by the Architect.
2. Provide 48 hours notice in writing to Architect prior to start of quality control panels.
3. Perform quality control panels using crew that will be executing the work and following requirements of this Section.
4. Allow quality control panels to dry for a minimum of seven (7) days before notifying Architect that they are ready for examination.
5. Repeat quality control panels as necessary to obtain approval by Architect.
6. Protect approved quality control panels to ensure that they are without damage, deterioration, or alteration at time of Substantial Completion.
7. Approved panels in undamaged condition at time of Substantial Completion may be incorporated into the Work.
8. Approved quality control panels will represent minimum acceptable standards for masonry cleaning work. Subsequent work that does not meet standards of approved quality control panels will be rejected.

B. Prepare following quality control panels:

1. Cleaning General Soiling from Brick Masonry: As designated by the Architect.
2. Cleaning Metallic Stains from Masonry: As designated by the Architect.
3. Cleaning Mortar and Paint Drips from Masonry: As designated by the Architect for each type of masonry.
4. Protection of Windows and Wood and Metal Elements: As designated by the Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products and materials only after they have been approved by Architect and after MSDS sheets for products and materials have been submitted and are available in Contractor's onsite office.
- B. Deliver and store materials in manufacturers' original sealed containers or packaging, clearly labeled with manufacturer's name, address, and product identification, including grade, type, and color. Immediately reseal containers after partial use.
- C. Store all materials in spaces designated by Owner. All such spaces shall comply with pertinent federal, state, and local laws, codes, and regulations and shall be locked and inaccessible to those not employed under this Section, except Owner's Representatives.
  1. Maintain temperatures in storage spaces within range recommended by manufacturer of material being stored in each case. Protect liquid components from freezing.
- D. Deliver, store, and handle all products and materials to prevent damage, deterioration, or degradation and intrusion of foreign material.
- E. Discard and remove from site deteriorated or contaminated materials and products that have exceeded their expiration dates. Replace with fresh materials.

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1.7 PROJECT CONDITIONS

- A. Laws and Regulations: Conduct all masonry cleaning work and dispose of all residue from such work in complete compliance with all applicable federal, state, and local laws and regulations.
- B. Protection of Persons: Take all measures necessary to protect persons, whether involved with work of this Section or not, from harm caused by work of this Section.
  - 1. Erect temporary protective covers at points of entrance and exit to building that must remain in operation during course of masonry cleaning work when work is ongoing around or above entrances and exits.
  - 2. Provide temporary enclosures, barricades, signage, and other forms of protection to prevent persons, except properly protected cleaning personnel, from coming in contact with cleaning materials.
- C. Protection of Building: Protect all building elements and finishes from damage or deterioration caused by masonry cleaning work using all means necessary.
  - 1. Adjacent Materials: Protect adjacent materials, including but not limited to masonry, metals, glass, paint, and sealants, from cleaning solutions that might damage such materials.
  - 2. Spread of Cleaning Solutions: Do not clean masonry during winds of sufficient force to spread cleaning solutions to unprotected surfaces. Cease cleaning operations when winds may carry chemicals, rinse water, or run-off from chemical cleaning to unprotected areas.
  - 3. Window and Door Openings and Other Penetrations in Building Skin: Use all means necessary to prevent cleaning solutions and waste products from entering behind building skin at penetrations in skin.
- D. Protection of Surroundings: Protect adjacent buildings, site, landscape features, public rights of way, motor vehicles, and other surrounding elements from damage and deterioration resulting from masonry cleaning work.
  - 1. Collect and dispose of runoff from cleaning and paint removal operations by legal means and in manner that prevents soil erosion, undermining of paving and foundations, damage to sidewalks, water penetration into building interiors, and any harm to buildings, landscape elements, and natural bodies of water or water table.
  - 2. Provide troughs to direct run-off resulting from masonry cleaning operations.
- E. Contract Drawings: Drawings are two-dimensional representations of three-dimensional objects and do not show all surfaces. Perform work on all surfaces of projections, reveals, ornament, and other elements associated with areas on which work is indicated.
- F. Coordination: Coordinate work of this Section with work of other specification sections to ensure proper completion of all Work.
  - 1. Clean masonry before beginning masonry restoration.
  - 2. Schedule and stage masonry cleaning so that no runoff from cleaning operations comes in contact with previously cleaned masonry elements.

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1.8 ENVIRONMENTAL REQUIREMENTS

- A. Use of Water: Do not perform masonry cleaning work that will wet masonry materials or cause them to be wet when ambient temperature is below 40 degrees Fahrenheit, nor when temperature of air or masonry is expected to drop below 40 degrees Fahrenheit within 72 hours. Take all precautions necessary to protect building and materials from freezing. No work shall begin when any part of wall or materials in use are frozen or subject to freezing.

1.9 COLLECTION AND DISPOSAL OF WASTE PRODUCTS

- A. General: Collect, contain, test, and dispose of solid and liquid wastes in accordance with applicable federal, state, and local laws and regulations.
- B. Provide troughs and gutters to collect runoff from cleaning operations for pretreatment prior to disposal. Do not allow waste materials from cleaning operations to flow or drop onto adjacent sidewalks, plantings, soil, or structures. Direct waste materials to collection vessels for treatment.
- C. Neutralize all cleaning waste products to a pH of between 5.0 and 6.5. Propose specific methods and materials for neutralization in Waste Disposal Program submission.
- D. Dispose of cleaning run-off by legal means that prevent: erosion, undermining, damage to plant material, and water penetration into building.
  - 1. Install protection and waste collection systems before general cleaning begins.
  - 2. Test all drains and other water removal systems to ensure that they are functioning properly before cleaning operations begin. Notify Owner immediately if any drains or systems are stopped or blocked. Do not begin work of this Section until drains are in good working order.
  - 3. Provide filtration to prevent suspended solids such as masonry residue from entering drains and drain lines. Contractor shall be responsible for cleaning out any drain or drain line that becomes blocked or filled with sand or other solids as a result of work performed under this Section.
- E. Dispose of all waste products at regular intervals. Do not allow waste products to accumulate on site.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Grade and Quality: Materials shall conform to requirements of this Section and shall be new, free from defects, and of recent manufacture.
- B. Ready-Mixed Products: Wherever a ready-mixed product is specified for use, containers shall bear labels giving exact formula of mixture. Manufacturer shall guarantee formula, and product shall be subject to chemical analysis by a laboratory selected by Architect or authorized Owner Representative.

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- C. Manufacturer's Instructions: Comply with material manufacturer's instructions for use of products (including surface preparation, mixing, applying, drying, etc.). In case of conflict with requirements of this Section, the more stringent requirements shall govern.
- D. ASTM Standards: All materials shall comply with relevant ASTM standards.
- E. Chemical materials shall be safe for use and not in violation of federal, state, or local laws or regulations.

2.2 CLEANING CHEMICALS AND MATERIALS

- A. General: Subject to compliance with requirements, provide one of the named products or a comparable product for use in cleaning substrates and conditions indicated.
- B. Products: Cleaner for Removing General Soiling from Brick Masonry. Provide one of the following or a comparable product determined through testing:
  - 1. SureKlean Light Duty Restoration Cleaner, manufactured by ProSoCo, Inc., 3741 Greenway Circle, Lawrence, KS 66046. 800-255-4255.
  - 2. EK Restoration Cleaner, manufactured by ProSoCo, Inc., 3741 Greenway Circle, Lawrence, KS 66046. 800-255-4255.
  - 3. 2010 All Surface Cleaner, manufactured by ProSoCo, Inc., 3741 Greenway Circle, Lawrence, KS 66046. 800-255-4255.
- C. Products: Cleaner for Removing Metallic Stains from Brick Masonry: Provide one of the following or a comparable product.
  - 1. Artisan Masonry Rust Remover, manufactured by Chemique, Inc., 315 North Washington Avenue, Moorestown, NJ 08057 (800-225-4161).
  - 2. Sure Klean Ferrous Stain Remover, manufactured by ProSoCo, Inc. 3741 Greenway Circle, Lawrence, KS 66046. 800-255-4255.
  - 3. 940 Iron and Manganese Stain Remover, manufactured by Deidrich Technologies, Inc., 7373 South 6th St., Oak Creek, WI 53154 (800-323-3565).
- D. Products: Cleaners for Testing for Removing Biological Growth from Masonry. Provide one of the following or approved equal:
  - 1. Enviro Klean ReVive, manufactured by ProSoCo., Inc. 3741 Greenway Circle, Lawrence, KS 66046. 800-255-4255.
  - 2. D/2 Biological Solution, available from Limeworks.US.
  - 3. Artisan Organic Stain Remover, manufactured by Chemique, Inc., 315 North Washington Avenue, Moorestown, NJ 08057 (800-225-4161).
- E. Products: Removal of Mortar, Sealant, and Paint Drips from Brick Masonry: Provide wooden or plastic scrapers for removal of foreign deposits. Provide one of the following or a comparable product.

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1. Enviro Klean SafStrip, manufactured by ProSoCo., Inc. 3741 Greenway Circle, Lawrence, KS 66046. 800-255-4255.
  2. HT-716 Paint Remover, manufactured by Hydrochemical Techniques, Inc. 253 Locust Street, Hartford, CT 06114 (800-278-7681).
  3. Dicone NC15 or NC9, manufactured by ProSoCo, Inc., 3741 Greenway Circle, Lawrence, KS 66046. 800-255-4255.
- F. Water for Cleaning: Clean, potable, free of oils, acids, alkalis, salts, organic matter, soluble and insoluble iron, and other substances detrimental to surfaces being cleaned and non-staining.
1. Source: Water may be obtained from building water supply.

2.3 EQUIPMENT FOR WATER AND CHEMICAL CLEANING

- A. General: Provide all equipment and accessories to distribute water at pressures and flow rates required for masonry cleaning.
- B. Particulate Filter: Provide a 5-micron particulate filter in line with water supply. All water used for masonry cleaning shall be filtered.
  1. Replace particulate filter as required to provide filtered water with no particles greater than 5 microns at pressure and flow rate specified.
- C. Pressure Pumps: Pressure pumps capable of producing water flow at a rate of 6 gallons per minute at a pressure of 850 psi at nozzle on end of hose. Pumps, or a combination of pumps plus pressure reducing valves, shall have capability of providing water at a steady pressure and flow rate at all pressures from 300 psi to 850 psi. Pumps shall have working pressure gauges. Pumps found to be without working pressure gauges shall be removed from site and work shall cease until pumps have been replaced with pumps having working pressure gauges.
- D. In-line Pressure Gauges: Each water line used for pressure rinsing shall have a working pressure gauge within 20 feet of nozzle used for rinsing.
- E. Spray Nozzles for Pressure Rinsing: Nozzles shall be of nonferrous metal and shall have a minimum 25-degree fan tip.
- F. Brushes: Fiber bristle only. No metal bristle brushes are permitted.
- G. pH Indicator
  1. Electronic pH Indicator Pen: Suitable for use intended and approved by Architect or authorized Owner Representative.
  2. pH Strips or Paper: Non-staining litmus paper with appropriate range approved by Architect or authorized Owner Representative.

2.4 MIXING CHEMICAL CLEANING SOLUTIONS

- A. General: Chemical cleaning materials are to be diluted as recommended by manufacturer and developed by field testing. Specified dilutions may be modified to reflect particular conditions on the building.

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PART 3 - EXECUTION

3.1 GENERAL CLEANING REQUIREMENTS

- A. General: These requirements apply to all work of this Section.
- B. Areas To Be Cleaned: Clean all exterior masonry.
- C. Testing: Cleaning tests shall be performed to determine proper cleaning procedures, chemicals, chemical dilutions and dwell time. Following approval by the Architect or authorized Owner Representative, Quality Control Panels will be prepared based on this testing.
- D. Quality Control Panels: Prepare quality control panels and secure approval of Architect or authorized Owner Representative before beginning general masonry cleaning work.
- E. Cleaning Progress: Clean masonry systematically in full-height sections of material to be cleaned.
  - 1. Cleaning and Rinsing with Water: Begin all cleaning using water at *bottom* of section to be cleaned and proceed to *top* of section before moving to adjacent section to prevent chemical rundown from staining lower sections of masonry.
- F. Timing: Control timing of cleaning operations (including dwell times of cleaners) to ensure that specified times are maintained. Do not allow chemicals to remain on surfaces longer than specified dwell times.
- G. Water Pressure and Flow Rate: Limit water pressure and flow rates to maximum pressures specified herein and to lower pressures as required to avoid damaging masonry, metals, and sealants.
  - 1. If any building material is damaged or deteriorated by water rinsing, immediately cease work. Do not begin pressure rinsing again until water pressure and flow rate have been adjusted to avoid damage to building materials.
- H. Alteration: Cleaning procedures, including cleaning chemical, chemical dilution, and dwell time may be altered by Architect as required based on site conditions.
- I. Completion of Cleaning: Cleaned masonry shall match approved quality control panels. Areas are subject to additional cleaning as directed by Architect or Owner's Representative in order to match quality control panels. Work of masonry cleaning on each surface shall not be considered complete until Architect has inspected surface and so notified Contractor in writing.

3.2 QUALITY CONTROL PANELS

- A. General: Provide quality control panels for general cleaning of each type of masonry following requirements of "Quality Control Panels" Article, above.
  - 1. Provide protection and water collection facilities during quality control panel phase.
  - 2. Do not begin general masonry cleaning until Architect has approved quality control panels.

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3.3 NON-MASONRY PROTECTION

- A. General: Provide protection for all windows to remain during construction, wood elements, metal elements and any other non-masonry element on the building from chemical cleaners and pressurized water spray. Window protection system for each window opening shall match approved quality control panel to Architect's satisfaction.
- B. Install Protection System
  - 1. Protection shall be in place prior to any cleaning operations and remain in place until cleaning of each area has been approved by Architect.
  - 2. Following removal of non-masonry protection, thoroughly rinse all elements with non-pressurized water.

3.4 CLEANING MASONRY

- A. General: Clean masonry free of staining as indicated on the Drawings. Cleaned granite masonry shall match approved quality control panel to the satisfaction of Architect.

3.5 GENERAL CLEANING OF MASONRY USING LOW-PRESSURE WATER SOAKING AND/OR CHEMICAL CLEANERS

- A. General: Clean masonry free of general soiling using specified systems (to be determined by field-testing and the Architect). Pressurized water shall not exceed 850psi. Cleaned masonry shall match approved quality control panels.
- B. Remove soiling using low-pressure water misting and pressure rinsing:
- C. General: Clean masonry free of general soiling using chemical cleaners and pressurized water rinsing. Cleaned masonry shall match approved quality control panels.
- D. Remove soiling using chemical cleaners and pressure rinsing:
  - 1. Pre-wet masonry to be cleaned and areas directly beneath with pressurized water. Prewet thoroughly to prevent chemicals to be drawn to deep into masonry.
  - 2. With a soft bristle brush, apply chemical undiluted.
  - 3. Allow to dwell for period during testing, gently agitating the surface. Do not allow masonry to dry.
  - 4. Rinse all traces of chemical and residue using water at a pressure not to exceed 850 psi, and a rate not to exceed 6 gpm with a 25-degree fan tip nozzle.
- E. Repeat cleaning as specified above as required to achieve uniformly cleaned masonry surfaces matching approved quality control panels.
  - 1. Heavy stains may require poulticing using chemical cleaners for adequate removal. Follow all manufacturer's instruction for using cleaners as a poultice. Do not allow masonry surface to dry during poulticing.
  - 2. Heavy pressure washing, at a pressure exceeding 850psi, will not be deemed an acceptable method of cleaning and is not a substitute for repeat applications of chemical cleaners or manual scrubbing.



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3.6 REMOVAL OF METAL STAINS USING CHEMICAL CLEANERS

- A. General: Clean masonry free of metal stains using chemical cleaners and pressurized water rinsing. Cleaned masonry shall match approved quality control panels.
- B. Remove stains using chemical cleaners and pressure rinsing: (Products to be determined by field testing and the Architect).
  - 1. Rinse all traces of chemical and residue using water at a pressure not to exceed 850 psi, and a rate not to exceed 6 gpm with a 25-degree fan tip nozzle.
- C. Repeat cleaning as specified above as required to achieve uniformly cleaned masonry surfaces matching approved quality control panels.
  - 1. Heavy stains may require poulticing using chemical cleaners for adequate removal. Follow all manufacturer's instruction for using cleaners as a poultice. Do not allow masonry surface to dry during poulticing.
  - 2. Heavy pressure washing, at a pressure exceeding 850psi, will not be deemed an acceptable method of cleaning and is not a substitute for repeat applications of chemical cleaners or manual scrubbing.

3.7 REMOVAL OF DRIPPED MORTAR AND PAINT FROM MASONRY

- A. Remove dried mortar using wooden or plastic scrapers with blunt edges that will not mar the surface of the stone.
- B. Remove dried paint by gentle scraping or by use of a chemical stripper that is approved for use on each type of masonry being cleaned. Remove all stripper residue thoroughly by rinsing with pressurized water.

3.8 ADJUSTMENT AND PROTECTION

- A. Re-clean any surface that does not have a uniform clean appearance as required to match approved quality control panels.
- B. Protect cleaned surfaces from dirt and soiling from other than normal atmospheric pollution until project completion. Re-clean any surfaces that become soiled to satisfaction of Architect or Owner's Representative.

3.9 CORRECTIVE MEASURES

- A. Correct all work of this Section that does not meet requirements of this Specification to Architect or Owner's Representative's satisfaction at no cost to the Owner.

END OF SECTION

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SECTION 040112 – RESTORATION MORTARS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete mortar restoration as indicated on the Drawings, as specified herein, including, but not limited to, the following:
  - 1. Provide custom mortars for pointing brick masonry.
- B. Related Sections include the following:
  - 1. Masonry Cleaning – Section 040111.
  - 2. Masonry Repointing - Section 040115.
  - 3. Brick Restoration – Section 040116.

1.3 QUALITY ASSURANCE

- A. Masonry Restoration Specialist: Contractor that performs restoration mortars work shall be regularly engaged in preparation of mortars to match historic mortars. Contractor shall demonstrate to Owner's satisfaction that, within previous five (5) years, he has successfully performed and completed in a timely manner at least three (3) projects similar in scope and type to required work involving buildings designated as Landmarks by local governmental authorities; or buildings listed on the National Register of Historic Places or on a State Register of Historic Places or pre-qualifications acceptable to the Maine State Historic Preservation Office.
  - 1. Subcontractors: Subcontractors are bound by same requirements as Contractor. No subcontractors shall be employed unless approved in writing by the Architect or authorized Owner's Representative.
  - 2. Foreman: Mortar preparation shall be directly supervised by a full-time foreman with experience equal to or greater than that required of Restoration Specialist. Foreman shall be on site daily for duration of work of this Section. Same foreman shall remain on project throughout work unless his performance is deemed unacceptable.
  - 3. Mechanics: Mortar preparation shall be carried out by a steady crew of skilled mechanics who are thoroughly experienced with materials and methods specified, have a minimum of three (3) years experience with work on historic buildings similar to that required by this Section, and are familiar with design requirements. Contractor shall certify that mechanics employed for work of this Section fully understand project requirements. In acceptance or rejection of work of this Section, no allowance will be made for workers' incompetence or lack of skill.

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- B. The work of all masonry sections shall comply with the United States Department of the Interior *Secretary of the Interior Standards for Rehabilitation of Historic Buildings*.
- C. Source of Materials: Obtain mortar ingredients from a single source for each type of material required to ensure uniform quality, color, and texture.
- D. Field Supervised Construction: Notify Architect or authorized Owner Representative before beginning mortar preparation.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. General: Submit the following in compliance with requirements of Conditions of the Contract and Division 1 specification sections. Revise and resubmit each item as required to obtain approval of the Architect or authorized Owner Representative.
- C. Qualification Data: Submit qualification data for firm and personnel specified in "Quality Assurance" Article that demonstrates that both firm and personnel have capabilities and experience complying with requirements specified. For firm and foreman, provide a list of at least three (3) completed projects within the New England Region similar in size and scope to work required on this project. For each project list project name, address, Architect or Owner, conservator, supervising preservation agency, scope of contractor's work, and other specified information. This information shall be submitted with the offer.
- D. Program of Work: Written program for restoration work specified in this Section.
- E. Product Literature: Manufacturer's published technical data for each product to be used in work of this Section including recommendations for application and use. Include test reports and certificates verifying that product complies with specified requirements.
- F. Samples:
  - 1. Pointing Mortar: Cured mortar samples set in 1/2 in. by 6 in. plastic or aluminum channels for approval of color and texture. Samples shall be matched to existing original mortar as identified by Architect or authorized Owner Representative. Provide the following:
    - a. Mortar for brick masonry. (Four (4) samples)
- G. Mortar samples must be approved in writing by the Architect.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver materials to site until they have been approved by the Architect.
- B. Deliver and store materials in manufacturer's original sealed containers or packaging, clearly labeled with manufacturer's name, address, and product identification, including grade, type, and color. Immediately reseal containers after partial use.

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- C. Store materials in spaces designated by Owner. Such spaces shall comply with pertinent federal, state, and local laws, codes, and regulations and shall be locked and inaccessible to those not employed under this Section, except Owner's Representatives.
  - 1. Maintain temperatures in storage spaces within range recommended by manufacturer of material being stored in each case. Protect liquid components from freezing.
  - 2. Store products and materials at least 4 in. above floor and protect them from water, dampness, or high humidity.
- D. Deliver, store, and handle products and materials to prevent damage, deterioration, or degradation and intrusion of foreign material.
- E. Discard and remove from site deteriorated or contaminated materials and products that have exceeded their expiration dates. Replace with fresh materials.

1.6 PROJECT CONDITIONS

- A. Applicable Regulations: Perform work of this Section in accordance with federal, state, and local laws and regulations.
- B. Material Safety: Chemical materials shall be safe in use and shall comply with applicable federal, state, and local laws and regulations.
- C. Prohibited Materials: No masonry cements or masonry mortars will be permitted.
- D. Coordination: Coordinate preparation of mortars with work of Division 4 sections requiring mortars to ensure proper completion of Work.

1.7 ENVIRONMENTAL CONDITIONS

- A. General: Perform work only when temperature of products being used and air temperature and humidity comply with manufacturer's requirements and requirements of this Section. In case of conflict, the most stringent requirements shall govern.
  - 1. Remove all masonry work determined by the Architect to have been damaged by freezing conditions or high temperature and replace following these specifications to the Architect or authorized Owner Representative's satisfaction.
- B. Proprietary Materials: Do not use proprietary patching materials and mortars unless temperatures are between 50 degrees Fahrenheit and 80 degrees Fahrenheit and will remain within that range for at least 48 hours after work has been completed unless work at other temperatures is specifically approved by manufacturer and Architect.
- C. Mortars: Do not mix or use mortars when air or masonry temperature is below 40 degrees Fahrenheit or when it is expected to drop below 40 degrees Fahrenheit within 48 hours of mortar application unless the Architect or authorized Owner Representative has approved both Contractor's work proposal for cold-weather masonry work and also specific masonry work to be done in each instance.

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PART 2 - PRODUCTS

2.1 PRODUCTS

- A. White Portland Cement: Type I, ASTM C 150.
- B. Portland Cement: Type I or Type II, ASTM C 150, non-staining. Do not use masonry cement.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Sand: Clean sharp sand, free of loam, silt, soluble salts, organic matter, and other deleterious substances and graded in compliance with ASTM C 144, except that for joints less than 3/16" all aggregate shall pass through a number 16 sieve.
  - 1. Sand for Pointing Mortar: Sand shall match sand in existing original mortar in sieve analysis, grain configuration, and color so that pointing mortar will match color of existing mortar with no or minimum addition of pigment.
- E. Water: Clean and free of substances deleterious to mortar and masonry.
- F. Pigments: Stable, nonfading, alkali-resistant oxide pigments. Subject to compliance with requirements, provide one of the following or a comparable product:
  - 1. SGS Mortar Colors: Solomon Grind-Chem Services, Inc.
  - 2. True Tone Mortar Colors: Davis Colors, a Subsidiary of Rockwood Industries, Inc.
- G. No additives or admixtures other than those specified shall be used. No chlorides or aggressive corrosive chemicals shall be used.

2.2 MORTAR MIXES

- A. Mortars for Setting and Pointing Stone and Brick Masonry:
  - 1. Mortars specified hereinafter shall comply with ASTM C 1713, Standard Specification for Mortars for the Repair of Historic Masonry.
  - 2. Mix mortars using proportions specified herein as adjusted, if necessary, by the amount of moisture in the ingredients. The proportions specified are for dry cements and limes and damp, loose (saturated, surface-dry) sand. If ingredients with different moisture contents are used (for example, lime putty is used in place of lime or dry sand is used in place of damp, loose sand), adjust quantities so that the proportions of ingredients in the mixes equal the proportions specified as approved by Architect or authorized Owner Representative.
  - 3. Cement, lime, sand mortar. Proportion mortar by volume as follows to achieve a mortar with a minimum compressive strength of 415 psi at 7 days and 540 psi at 28 days. Mortar for setting stone units may omit the pigments.
    - a. 1 part by volume white Portland cement (Type I).
    - b. 2 parts by volume hydrated lime (Type S).
    - c. 7 parts by volume sieved sand (Schofield No. 219 sieved for fine and wide joints as specified and selected to match sand in original mortar).

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- d. Oxide pigments as needed to match original mortar color(s). Pigment shall not exceed a ratio of 10% by weight of the cementitious ingredients. Pigment may be omitted from the setting mortar.
- B. Preblended Dry Mortar Mix (Historic): Packaged blend made from portland cement and hydrated lime, sand, mortar pigments and complying with ASTM C1714/C1714M.
  - 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
    - a. Cathedral Stone
    - b. Edison Coatings.
    - c. SPEC MIX, LLC.

## 2.3 MIXING OF MORTAR

- A. Measure mortar ingredients carefully so that proportions are controlled and maintained throughout all work periods.
- B. Mix mortar in an approved type of power operated batch mixer. Mix for time required to produce a homogeneous plastic mortar but not less than five minutes: approximately two minutes for mixing dry materials and not less than three minutes for mixing after water has been added.
- C. Use minimum amount of water to produce a workable consistency for mortar's intended purpose.
  - 1. Mortar for Pointing: As dry a consistency as will produce a mortar sufficiently plastic to be worked into joints.
  - 2. Grouts for Injection: Consistency as will readily flow in cracks and voids.
  - 3. Mortar for Slurry: Consistency as will be brushable.
- D. After mixing, mortars for pointing or setting shall sit for 20 minutes prior to use to allow for initial shrinkage. Mortar shall be placed in final position within two (2) hours of mixing. Retempering of partially hardened material is not permitted.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation of Restoration Mortars shall be performed as part of the work of the following Sections:
  - 1. Masonry Repointing – Section 040115.
  - 2. Brick Masonry Restoration – Section 040116.

END OF SECTION

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SECTION 040115 – MASONRY REPOINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of masonry pointing, as indicated on the Drawings, as specified herein, including, but not limited to, the following:
  - 1. Prepare joints in brick masonry for repointing as indicated on the Drawings.
  - 2. Install new mortar in prepared joints in brick masonry, tool joints, and clean excess mortar from masonry surfaces.
- B. Related Sections include the following:
  - 1. Masonry Cleaning – Section 040111.
  - 2. Restoration Mortars - Section 040112.
  - 3. Brick Restoration – Section 040116.
  - 4. Joint Sealants - Section 079200.

1.3 QUALITY ASSURANCE

- A. Restoration Specialist: Contractor that performs masonry pointing shall be regularly engaged in pointing masonry on historic buildings. Contractor shall demonstrate to Owner's satisfaction that, within previous five (5) years, he has successfully performed and completed in a timely manner at least three (3) projects similar in scope and type to required work involving buildings designated as Landmarks by local governmental authorities; or buildings listed on the National Register of Historic Places or on a State Register of Historic Places or pre-qualifications acceptable to the Maine State Historic Preservation Office.
  - 1. Subcontractors: Subcontractors are bound by same requirements as Contractor. No subcontractors shall be employed unless approved in writing by Architect or authorized Owner's Representative.
  - 2. Foreman: Masonry pointing shall be directly supervised by a full-time foreman with experience equal to or greater than that required of Restoration Specialist. Foreman shall be on site daily for duration of work of this Section. Same foreman shall remain on project throughout work unless his performance is deemed unacceptable.
  - 3. Mechanics: Masonry pointing shall be carried out by a steady crew of skilled mechanics who are thoroughly experienced with materials and methods specified, have a minimum of three (3) years experience with work on historic buildings similar to that required by this Section, and are familiar with design requirements. Contractor shall certify that mechanics employed for work of this Section fully understand project requirements. In acceptance or rejection of work of this Section, no allowance will be made for workers' incompetence or lack of skill.

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- B. Testing of Workers: All technicians proposed for use on project will be required to successfully complete six (6) linear feet of cutting and raking of mortar joints in presence of the Architect prior to working on project. One one-quarter-inch chip of masonry per linear yard will be standard of acceptable skill. Unsuccessful performance in this test area will be grounds for rejection of this technician for this job.
- C. The work of all masonry sections shall comply with the United States Department of the Interior *Secretary of the Interior Standards for Rehabilitation of Historic Buildings*.
- D. Source of Materials: Obtain materials for masonry pointing from a single source for each type of material required to ensure a match in quality, color, and texture.
- E. Field Supervised Construction: Contractor shall notify the Architect or authorized Owner Representative before beginning masonry pointing work.
- F. Contract Drawings: Drawings are two-dimensional representations of three-dimensional objects and do not show all surfaces. Perform work on surfaces of projections, reveals, ornament, and other elements associated with areas on which work is indicated.
- G. Repair or replace all masonry units damaged during masonry pointing to the Architect or authorized Owner Representative's satisfaction.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. General: Submit the following in compliance with requirements of Conditions of the Contract and Division 1 specification sections. Revise and resubmit each item as required to obtain approval of the Architect or authorized Owner Representative.
- C. Qualification Data: Submit qualification data for firm and personnel specified in "Quality Assurance" Article that demonstrates that both firm and personnel have capabilities and experience complying with requirements specified. For firm and foreman, provide a list of at least three (3) completed projects within the New England region similar in size and scope to work required on this project. For each project list project name, address, Architect or Owner, conservator, supervising preservation agency, scope of contractor's work, and other specified information. This information shall be submitted with the offer.
- D. Program of Work: Written program for restoration work specified in this Section.
- E. Samples:
  - 1. Mortar: Samples of all mortar required for work of this Section are to be submitted as required by Section 040112 – Restoration Mortars.
- F. Product Literature: Manufacturer's published technical data for each product to be used in work of this Section including recommendations for application and use. Include test reports and certificates verifying that product complies with specified requirements.



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- G. Prepare quality control panels as specified in Article "Quality Control Panels," below.

1.5 QUALITY CONTROL PANELS

- A. General: Before beginning general masonry pointing work, prepare quality control panels to provide standards for work of this Section. Do not proceed with masonry pointing until the Architect or authorized Owner Representative has approved relevant quality control panel.
1. Locate quality control panels in locations as directed by the Architect.
  2. Provide 48 hours notice to the Architect prior to start of each quality control panel.
  3. Perform quality control panels using crew that will be executing the work and following requirements of this Section.
  4. Allow each quality control panel to stand until mortar is thoroughly dry and has reached its natural color (48 -72 hours). Notify the Architect that panel is ready for inspection.
  5. Repeat quality control panels as necessary to obtain the Architect approval.
  6. Protect approved quality control panels to ensure that they are without damage, deterioration, or alteration at time of Substantial Completion.
  7. Approved quality control panels in undamaged condition at time of Substantial Completion may be incorporated into the Work.
  8. Approved quality control panels will represent minimum acceptable standard for masonry pointing work. Subsequent work that does not meet standard of approved quality control panels will be rejected.
- B. Prepare the Following Quality Control Panels:
1. Joint Preparation in Brick Masonry.
  2. Joint Pointing in Brick Masonry.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver materials to site until they have been approved by the Architect.
- B. Deliver and store materials in manufacturers' original sealed containers or packaging, clearly labeled with manufacturer's name, address, and product identification, including grade, type, and color. Immediately reseal containers after partial use.
- C. Store all materials in spaces designated by Owner. Such spaces shall comply with pertinent federal, state, and local laws, codes, and regulations and shall be locked and inaccessible to those not employed under this Section, except Owner's representatives.
1. Maintain temperatures in storage spaces within range recommended by manufacturer of material being stored in each case. Protect liquid components from freezing.
  2. Store products and materials at least 4 in. above floor and protect them from water, dampness, or high humidity.
- D. Deliver, store, and handle products and materials to prevent damage, deterioration, or degradation and intrusion of foreign material.
- E. Discard and remove from site deteriorated or contaminated materials and products that have exceeded their expiration dates. Replace with fresh materials.

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1.7 PROJECT CONDITIONS

- A. Applicable Regulations: Perform work of this Section following applicable federal, state, and local laws and regulations.
- B. Safety: Provide measures necessary to protect all persons, whether or not involved with work of this Section, from risk or harm caused by work of this Section.
- C. Protection of Building and Property:
  - 1. Protect adjacent elements and materials from damage or deterioration during work of this Section. Provide necessary protection and procedures to protect masonry not being pointed and all other elements and materials.
  - 2. Repair damage to elements and materials caused by masonry pointing work, using mechanics experienced in respective type of work, to satisfaction of the Architect or Owner.
  - 3. Protect components of storm drainage systems against damage and blockage caused or accelerated by work of this Section.
  - 4. Protection from Weather: Protect exposed areas of building, including areas of masonry from which mortar has been removed, from penetration by wind, water, or other forces at times when work is not in progress. Cover openings when work is not in progress.
- D. Protection of Environment: Provide precautions necessary to protect site, site features, surrounding buildings, streets and sidewalks, air, water, and other elements of environment from damage or deterioration caused by work of this Section.
- E. Dust: Minimize dissemination of dust to greatest extent possible.
  - 1. Provide dust collection hoods for all cutting tools connected to a vacuum collection system, or other comparable method.
  - 2. Contractor shall hold Owner, the Architect or authorized Owner Representative, and their consultants harmless from all claims relating to dust resulting from work of this Section.
- F. Protection of Masonry Being Pointed: Protect existing masonry from damage during work of this Section. Take special care in removing existing mortar to ensure that no arrises are damaged, chipped, or broken. Contractor shall replace or repair any masonry unit damaged in any manner by work of this Section as directed by and to satisfaction of the Architect.
- G. Staining: Prevent grout or mortar from staining face of masonry to be left exposed. Protect sills, ledges, and projections from mortar droppings. Immediately remove grout or mortar in contact with such masonry. Protect base of walls from rain splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
- H. Protection from Rain: Protect pointed joints with heavy waterproof sheeting from direct attack by rain or other precipitation for at least 24 hours after mortar has been applied.
- I. Coordination: Coordinate work of this Section with work of other Division 4 sections to ensure proper completion of masonry work.

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- J. Contract Drawings: Drawings are two-dimensional representations of three-dimensional objects and do not show all surfaces. Perform work on all surfaces of projections, reveals, returns, ornament and other elements and surfaces associated with areas on which work is indicated.
- K. Access for Inspection and Approvals: Provide the Architect or authorized Owner Representative access on a regular basis to quality control panels, areas on which work is ongoing, and where work has been completed to allow for inspections and approvals. Provide means of access and safety precautions required to facilitate inspections and approvals.

1.8 ENVIRONMENTAL CONDITIONS

- A. Use of Materials: Use materials only under the following conditions unless more stringent conditions are specified by product manufacture. The most stringent conditions shall govern.
  - 1. Cement and Lime Mortars: Prepare and use only when substrate and ambient air temperatures are between 40 degrees Fahrenheit and 90 degrees Fahrenheit. Protect installed mortar by approved methods when exposed to sunlight and when temperatures are above 80 degrees Fahrenheit.
- B. Cold Weather Masonry Construction: Do not proceed with masonry construction when masonry temperature or ambient air temperature is below 40 degrees Fahrenheit or when ambient air temperature is expected to drop below 40 degrees Fahrenheit within 72 hours of use of mortar.
  - 1. Remove all masonry work determined by the Architect or authorized Owner Representative to have been damaged by freezing conditions and rebuild following requirements of these specifications to the Architect or authorized Owner's Representative satisfaction.
- C. Hot Weather Masonry Construction: Protect work during hot weather (ambient air temperature above 80 degrees Fahrenheit, direct sunlight, or windy conditions) from premature drying or too rapid curing by use of dampened fabric coverings or other approved methods.

PART 2 - PRODUCTS

2.1 TOOLS

- A. Hand Tools: Chisels, hammers, and mallets.
  - 1. Thickness of Chisels: Chisels used to remove mortar from and to otherwise prepare joints shall have a maximum thickness of 5/8 times joint width extending back from tip of chisel a minimum of two (2) times depth at which chisel will be inserted into joint.
  - 2. Special Tools: Provide special knives or special thin cutter blades for use in joints less than 1/8 in. wide.
- B. Power Tools: Small, hand-held electric grinders with diamond or abrasive blades no greater than 3/32 in. thick and a maximum of 4-1/2 in. in diameter may be used to cut joints only under certain conditions as described in Part 3, below, and if specifically approved by Architect.
- C. Brushes: Stiff, natural bristle brushes.
- D. Trowels for Pointing: Long, thin pointing trowels that are narrower than joints being pointed.

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1. Fabricate special trowels for pointing if necessary to provide for proper insertion and compaction of mortar.

2.2 MORTAR

- A. Follow requirements of Section 040112 – “Restoration Mortars”. Mortar shall match existing original mortar in cleaned masonry in color, texture, and other visual qualities to satisfaction of Architect.

2.3 SEALANT

- A. Follow requirements of Section 079200 - Joint Sealants.

PART 3 - EXECUTION

3.1 GENERAL PREPARATION

- A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of work. Do not proceed until unsatisfactory conditions have been corrected.
- B. Before using power grinders or hand methods that generate airborne dust, erect dust impervious barriers to prevent escape of dust. Take all other necessary measures to prevent dust from traveling beyond work area.

3.2 JOINT PREPARATION

- A. Remove mortar from joints to a depth of twice the width of the joint or to sound mortar, whichever is greater. In all cases remove all weathered and loose material.
- B. Take all necessary precautions to ensure that faces and arises of masonry units are not damaged in any way during joint preparation.
- C. For joints of 1/8 inch or less in width, rake mortar from joints manually with a sharp knife blade such as an abrasive-coated blade (blade made for reciprocating saws or saber saws) attached to a metal or wood handle to be used by hand.
- D. For joints of 1/16 inch or less, rake mortar from joints manually with a curved-blade linoleum knife.
- E. Joint preparation shall cease if, in judgment of Architect or authorized Owner Representative, Contractor's methods are damaging masonry units. Work shall not resume until tools, workmen, and methodology are corrected to meet standard of approved quality control panel.
- F. Remove all mortar and sealants from surfaces of masonry units adjoining joint to allow new mortar to bond directly with masonry units. Surface at rear of joint shall be uniform and roughly perpendicular to sides of joint.
- G. Mortar Removal:

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1. Hand Tools: Use hand tools for removal of mortar from joints less than 6 in. long and from all other joints in which use of power tools might cause damage to masonry units. Use hand tools to complete mortar removal from joints where power tools have been used to partially remove mortar.
    - a. Sharpen chisels hourly to minimize chipping.
  2. Power Tools: With **specific prior approval** from Architect following successful demonstrations of skill by mechanics, power grinders may be used to partially remove mortar from horizontal joints in stone masonry and from joints wider than 3/16 inch and longer than 6 in. in stone masonry where there is no danger of cutting into adjacent masonry units.
    - a. Demonstrated Ability of Mechanics: Prior to beginning work, demonstrate that all workmen using power tools are proficient in use of power tools for joint preparation. Failure to demonstrate to satisfaction of the Architect that each worker is proficient and that power tool joint preparation does not result in damage to masonry to remain shall result in prohibition of use of power tools for joint preparation. If proficiency is not demonstrated, or if work in progress results in damage to masonry to remain, all power tool work shall cease, and joints shall be prepared using hand tools.
    - b. Limitations on Use of Power Tools:
      - 1) Do not use power grinders on joints less than 3/16 in. wide or less than 6 in. long or where projections, ornament, or other surface irregularity might make damage to masonry units likely.
      - 2) Use power grinder only to score one kerf in center of each joint to depth of mortar removal required. Remove remaining mortar using hand tools.
      - 3) Stop kerf at least 4 in. from inside corners and projecting elements. Remove remaining mortar using hand tools.
      - 4) Contractor may construct jigs to guide power tools and to prevent damage to adjacent masonry.
      - 5) **UNSUCCESSFUL PERFORMANCE AND/OR DAMAGE MAY BE GROUNDS FOR OWNER'S REMOVAL OF THE TECHNICIAN AND MAY REQUIRE REPLACEMENT OF MASONRY AS DETERMINED BY THE ARCHITECT OR AUTHORIZED OWNER REPRESENTATIVE, AT THE EXPENSE OF THE CONTRACTOR.**
- H. Cleaning: Remove loose mortar and foreign material from raked joints using a fine, stiff natural bristle brush. Remove remaining particles, dust, and dirt using filtered, oil-free compressed air. Ensure that dust and dirt are not blown back into joints that have previously been cleaned.
- I. Repair or replace masonry units damaged during joint preparation process to satisfaction of Architect or Owner.
- 3.3 MORTAR APPLICATION
- A. Wetting: Thoroughly wet masonry 24 hours prior to and again immediately before pointing. Let surfaces dry slightly. At time of pointing, surfaces should be damp, so that they do not rapidly absorb moisture, but free of standing water.
- B. Pointing: Point joints as follows:

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1. Using a long, thin pointing trowel, tightly pack mortar into joints in layers not exceeding 1/4 in. thick to fill joint to match original sound joints.
2. Begin by filling areas from which mortar is missing to a depth greater than 3/4 in. in 1/4-in.-thick layers to within 3/4 in. of wall surface to provide a uniform substrate for final pointing. Fill final 3/4-in. depth continuously and uniformly in 1/4-in.-thick layers.
3. Firmly iron each layer to compact mortar to ensure a full bond between mortar and masonry and a firm, solid joint.
4. Allow each layer to reach thumbprint hardness before applying succeeding layer. Do not let previous layer dry out before applying succeeding layer. Construct uniform joints.
5. Do not spread mortar over edges onto exposed surfaces of masonry units. Do not featheredge mortar.
6. When stopping work at end of each day or for other reasons, stagger layers of mortar so that there will be no through joints in pointing. Stagger joints in layers so that they are at least 3 in. from each other.
7. Where one day's work joins that of the previous day, dampen previous work to ensure a good bond.

C. Joint Tooling

1. Tooling: After final layer of mortar is "leather hard," tool joints as indicated on Drawings.
2. Profile: Tool joints to profile to match original historic joint profile. Solidly compress mortar so that it adheres well to masonry on both sides and forms a dense surface. Premature or late tooling will result in unacceptable finishes that will be rejected.
3. Duplicate the finish of a slightly weathered joint by brushing newly pointed joints with a nonmetallic natural fiber bristle brush to produce a slight texture.

D. Curing

1. Keep newly pointed joints damp for at least 48 hours after mortar has been inserted. Do not apply a direct stream of water to joints for at least 24 hours after mortar has been placed.
2. Ensure masonry temperature remains as required by specifications until mortar is thoroughly cured.

E. Cleaning And Repair Of Mortar Joints

1. Water Washing: Wash pointed masonry with clean filtered water and nonabrasive hand tools to remove mortar debris from masonry surfaces.
  - a. Wash with water within 48 hours following completion of pointing.
  - b. Use blunt-edged wood scrapers, stiff natural bristle brushes, and rough towels along with water to remove mortar debris. Do not use wire brushes.
2. Repair of Pointed Joints: As cleaning progresses, examine joints to locate cracks, holes, and other defects. Carefully point up and fill such defects with mortar. Where necessary in opinion of Architect, cut out joints and refill with pointing mortar exercising extreme care to ensure that color matches that of original pointing work. Exposed joint surfaces shall be free from protruding mortar, holes, pits, depressions, and other defects.

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3.4 SEALANT INSTALLATION

- A. Follow the requirements of Section 079200 – “Joint Sealants”.

3.5 CORRECTIVE MEASURES

- A. Should a crack occur in a joint surface or should mortar separate from masonry unit, cut out mortar and repoint following requirements of this Section to satisfaction of Architect or authorized Owner’s Representative.
- B. Should Architect or Owner determine that any masonry pointing work does not equal or exceed minimum standard established by approved quality control panel, cut out mortar and repoint following requirements of this Section to Architect or Owner satisfaction at no cost to the Owner.

END OF SECTION

SECTION 040116 – BRICK MASONRY RESTORATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of brick masonry restoration as shown on the Drawings, as specified herein, and as may be required by conditions and authorities having jurisdiction, including, but not limited to, the following:
  - 1. Providing new brick matching existing brick to replace damaged brick and deteriorated brick as indicated on Drawings.
  - 2. Preparing and pointing joints in brick masonry.
  - 3. Removing sealant from perimeter of indicated brick window and door openings and installing new sealant.
- B. Related Sections include the following:
  - 1. Masonry Cleaning – Section 040111.
  - 2. Restoration Mortars - Section 040112.
  - 3. Masonry Repointing - Section 040115.
  - 4. Joint Sealants - Section 079200.

1.3 QUALITY ASSURANCE

- A. Masonry Restoration Specialist: All brick restoration work shall be performed by a firm regularly engaged in restoration of brick masonry on historic buildings. Firm shall demonstrate Owner's satisfaction that, within previous five (5) years, they have successfully performed and completed in a timely manner at least three (3) projects similar in scope and type to required work involving facilities designated as landmarks by local governmental authorities or buildings listed on the National Register or State Registers of Historic Places under the supervision of preservation authorities or pre-qualifications acceptable to the Maine State Historic Preservation Office.
  - 1. Foreman: Brick masonry restoration shall be directly supervised by a full-time foreman with experience equal to or greater than that required of Restoration Specialist.
  - 2. Mechanics: Brick masonry restoration shall be carried out by skilled mechanics who are thoroughly experienced with materials and methods specified, have a minimum of three (3) years experience with work on historic buildings similar to that required by this Section, and are familiar with design requirements.



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- B. Mechanic's Samples: All mechanics planned for use on project shall successfully complete specified samples of representative types of work in presence of the Architect prior to working on project. Unsuccessful performance in these sample areas shall be grounds for rejection of this technician for work on project
  - C. Laws, Codes, and Regulations: Work of this Section shall comply with applicable federal, state, and local laws, codes, and regulations.
  - D. Referenced Standards: Work of this Section shall comply with applicable requirements and recommendations of latest editions of the documents listed herein, except as modified by more stringent requirements of the Contract Documents and of applicable laws, codes, and regulations of authorities having jurisdiction. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless specifically indicated otherwise in Contract Documents. Provide a reference copy of each of the following standards at Project site during all periods when work of this Section is being performed. In each case in which there is a conflict between requirements of referenced standards; requirements of laws, codes, and regulations; and requirements of this Section, the most stringent or restrictive requirement shall govern.
    - 1. ASTM C 62, Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
    - 2. ASTM C 216, Standard Specification for Facing Brick.
    - 3. United States. Department of the Interior, *Secretary of the Interior Standards for Rehabilitation of Historic Buildings*.
  - E. Sources of Materials: Obtain each type of material required for brick masonry restoration from a single source to ensure a match in quality, performance, and appearance.
  - F. Access for Observation and Approvals: Provide Architect or authorized Owner's Representative access on a continuing basis to locations on which mock-ups are being carried out, on which work is ongoing, and where work has been completed to allow for observation and approvals.
  - G. Restoration of Damaged Masonry Units: Repair or replace all broken, lost, and damaged masonry units resulting from work of this Section to Architect or Owner's satisfaction at no additional cost to Owner.
  - H. Shoring and Bracing: Provide shoring and bracing required to ensure stability of stone and brick masonry during work of this Section. If during work of this Section, there is any possibility that removal of masonry units or other work will in any way affect the stability of the remaining masonry or allow portions of the remaining masonry to move or become displaced, provide shoring and bracing to ensure stability of masonry walls.
- 1.4 ACTION SUBMITTALS
- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
  - B. General: Submit the following in compliance with the requirements of the Contract Documents. Revise and resubmit each item as required to obtain Architect or authorized Owner Representative's approval.

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- C. Qualification Data: Submit qualification data for firm and personnel specified in “Quality Assurance” Article that demonstrates that both firm and personnel have capabilities and experience complying with requirements specified. For firm and foreman, provide a list of at least three completed projects similar in size and scope to the work required on this Project. For each project list project name, address, Architect or Owner, conservator, supervising preservation agency, scope of contractor’s work, and other relevant information. Submit this information with the offer.
- D. Program of Work: Submit a written program for restoration work specified in this Section.
  - 1. Materials and Procedure: Materials, methods, tools, and equipment to be used for all phases and tasks of stone masonry restoration work.
  - 2. Protection: Description, including drawings and diagrams, of proposed materials and methods of protection for preventing harm, damage, and deterioration caused by work of this Section to persons (whether involved in the Work or not); building elements, materials, and finishes; surrounding landscape and site; and the environment (including air and water).
    - a. Include procedures for hot weather masonry construction and cold weather masonry construction.
  - 3. Alternate Methods and Materials (If Any): Proposed alternate methods and materials (if any) to those specified for stone masonry restoration work. Provide evidence of successful use on comparable projects and demonstrate effectiveness for use on this Project.
- E. Product Data: Manufacturer’s published technical data for each product to be used in work of this Section including material description, chemical composition (ingredients and proportions), physical properties, recommendations for application and use, test reports and certificates verifying that product complies with specified requirements, and Material Safety Data Sheets (MSDS).
- F. Samples
  - 1. Face Brick: Sets of each type of brick to be used including sufficient numbers of brick to show full range of colors and textures to be expected in completed work. Brick shall match existing brick.
  - 2. Mortar for Pointing Brick Masonry: Cured mortar samples set in 1/2-inch by 6-inch plastic or aluminum channels for approval of color and texture. Samples shall match existing mortar.
  - 3. Sand for Brick Pointing Mortars: Five-pound sample of each type of sand proposed for use in pointing mortars and grouts. Include sieve analysis (ASTM C 144).
  - 4. Custom Patching Mortar for Patching Losses in Brick: 4-inch x 4-inch x 1-inch cured samples of each type and color of mortar required for approval of color and texture. Samples shall match existing brick in color, texture, surface reflectance, and other properties.
  - 5. Anchors and Fasteners: Each type and configuration specified and/or proposed for work of this Section.
  - 6. Reinforcing: Each type and configuration, 12-inch-lengths.
  - 7. Accessories: Each type proposed for use in work of this Section.

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1.5 QUALITY CONTROL PANELS

1. General: Before beginning general exterior brick restoration, prepare quality control panels to provide standards for work of this Section. Do not proceed with exterior stone restoration until Architect has approved relevant quality control panels in writing.
  1. Locate quality control panels in locations as directed by or acceptable to Architect.
  2. Provide 48 hours' notice to Architect prior to start of each quality control panel.
  3. Repeat quality control panels as necessary to obtain approval by Architect.
  4. Protect approved quality control panels to ensure that they are without damage, deterioration, or alteration at time of Substantial Completion.
  5. Approved quality control panels in undamaged condition at time of Substantial Completion may be incorporated into the Work.
  6. Approved quality control panels will represent minimum acceptable standard for exterior stone restoration work. Subsequent work that does not meet standard of approved quality control panels will be rejected.
- B. Prepare the Following Quality Control Panels
  1. Providing new brick matching existing brick to replace damaged brick and deteriorated brick: Four locations.
  2. Preparing Joints in Brick Masonry: One panel, minimum 4 sq. ft.
  3. Pointing Joints in Brick Masonry: One panel, minimum 4 sq. ft.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver materials to site until they have been approved by the Architect.
- B. Deliver and store materials in manufacturers' original sealed containers or packaging, clearly labeled with manufacturer's name, address and product identification, including grade, type, and color. Immediately reseal containers after partial use.
- C. Store all materials in spaces designated by Owner. All such spaces shall comply with pertinent federal, state, and local laws, codes, and regulations.
  1. Maintain temperatures in storage spaces within range recommended by manufacturer of material being stored in each case. Protect liquid components from freezing.
  2. Store products and materials at least 4 inches above floor and protect them from water, dampness, or high humidity.
- A. Deliver, store, and handle all products and materials to prevent damage, deterioration, degradation, and intrusion of foreign material.
- B. Discard and remove from site deteriorated materials, contaminated materials, and products that have exceeded their expiration dates. Replace with fresh materials.

1.7 PROJECT CONDITIONS

- A. Safety: Protect all persons, whether or not involved in the work of this Section, from harm caused by or resulting from work of this Section.

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1. Protection from Hazardous Materials: Use procedures necessary to protect workers and other persons from contact with hazardous materials resulting from work of this Section.
  - a. Silica: Use procedures necessary to protect workers and other persons from exposure to respirable crystalline silica. All work should be performed in compliance with applicable OSHA regulations, including but not limited to “Respirable Crystalline Silica Standard” (Title 29, Code of Federal Regulations (CFR) Section 1926.1153) and with other applicable state and local laws and regulations.
- B. Protection of Building: Protect building elements and finishes from damage and from deterioration caused by work of this Section. Repair damage to materials and damage to finishes to Architect or Owner’s satisfaction at no additional cost to Owner.
  1. Exclusion of Water: Cover open joints and areas from which units have been removed during periods when work is suspended to ensure materials and finishes are not damaged by water penetration.
  2. Prevention of Staining: Prevent grout, mortar and adhesives from staining exposed faces of masonry.
  3. Protection from Fire: Take precautions necessary to prevent fire and spread of fire.
    - a. Covers: Membranes, insulation blankets, and other materials used to cover masonry shall be flame retardant and fire resistant.
    - b. Warming Devices: Heating blankets, infrared heaters, and other warming devices shall be UL approved and inspected for damage before use.
    - c. Open Flame Heaters: No open flame heaters shall be used to protect finished masonry.
- C. Protection of Site and Surroundings: Protect adjacent buildings, site, landscape features, public rights of way, motor vehicles, and other surrounding elements from damage and deterioration resulting from work of this Section.
  1. Protect lawns, plantings, and landscape features in a manner that will allow light and water to reach them.
  2. Provide for collection and disposal of all excess water used in preparation of mortars and grouts and of all water runoff from procedures of pre-wetting masonry and misting pointed masonry to prevent contaminated water from damaging lawns, plants, trees, and other elements.
- D. Dust: Use procedures necessary to limit dust generated in the execution of work of this Section and to minimize dissemination of dust generated during work of this Section to greatest extent possible.
  1. Contractor shall hold Owner, Architect, and their consultants harmless from all claims relating to dust resulting from work of this Section.
- E. Coordination
  1. Coordinate work of this Section with work of other sections as required to ensure optimum performance of all work of this Contract and to avoid disturbance of critical Owner operations due to noise, dust, etc.
  2. Clean brick masonry as specified in Section 04 01 10 – “Masonry Cleaning” before beginning brick masonry restoration.

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1.8 ENVIRONMENTAL REQUIREMENTS

A. General:

1. Manufacturer's Recommendations: Perform work only when temperature of products being used, temperatures of existing and new materials and surfaces, and temperature and humidity of air at Project site comply with manufacturer's requirements and recommendations.
2. Requirements of Referenced Standard: Perform work of this Section in compliance with the requirements of Section 04 00 10 – "Cold and Hot Weather Masonry" and recommendations of Brick Industry Association (BIA), Technical Notes 1, *Cold and Hot Weather Construction*, June, 2018.
3. Conflicting Requirements: In each case in which there is a conflict between manufacturer's recommendations, recommendations of referenced standards, and other requirements specified in this Section, the most stringent and restrictive requirement shall govern.

B. Cold Weather Brick Masonry Restoration: Cold weather brick masonry restoration shall adhere to following requirements for work, performed in ambient temperatures indicated. Work shall not be permitted when temperature of air or wall is below 40 deg F or when temperature of air or wall is predicted to be below 40 deg F in Project location within 48 hours of work by the National Weather Service without Architect's prior written approval. No work shall begin when any part of wall or materials in use are frozen or subject to freezing temperatures.

1. Remove all masonry work determined by Architect to have been damaged by freezing conditions and rebuild following requirements of these specifications to Architect's satisfaction. Replace work to comply with requirements of this Section.

C. Hot Weather Brick Masonry Restoration: Protect fresh mortar from premature drying when temperature, humidity, and wind conditions result in rapid drying of mortar. Provide and maintain tarps against wind and direct sun. Protect masonry for 72 hours after using mortar by one of the following procedures:

1. Water-Soaked Cover: Provide and maintain damp burlap or other damp cloths over masonry to protect mortars from pre-mature drying. Install, maintain, and remove coverings using materials and methods that do not damage or alter masonry.
2. Fog Spray: Fog spray newly constructed masonry until damp at least three times a day using water without iron or other contaminants that might adversely affect masonry. Do not use water stream or pressure that might wash binder from surface of mortar or cause rundown on masonry.

PART 2 – PRODUCTS

2.1 BRICK

- A. Salvaged Face Brick: Sound, whole, salvaged brick cleaned free of mortar, grout, dirt, and other contaminants.
- B. New Face Brick: Replacement face brick shall comply with requirements of ASTM C 216, Grade SW, shall have a minimum compressive strength of 10,000 psi, and shall match existing original face brick in hardness and weatherability, size, color, and surface texture and reflectance.
  1. Brick: Match existing size, color, and texture.

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2. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated “not effloresced.”
  - C. New Common Brick: Replacement common brick for backup construction shall comply with requirements of ASTM C 62, Grade SW, shall have a minimum compressive strength of 6,000 psi, and shall match existing common brick in size.
    1. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated “not effloresced.”
- 2.2 MORTAR AND PATCHING MATERIALS
- A. Mortars for Setting and Pointing Brick Units: Comply with requirements of Section 040112 - “Restoration Mortars.”
  - B. Mortars and Grouts for Brick Repairs: Comply with requirements of Section 040112 – “Restoration Mortars.”
- 2.3 MISCELLANEOUS MATERIALS
- A. Pointing Trowels: Long, thin pointing trowels narrower than joints being pointed.
    1. Fabricate special custom trowels for masonry pointing as necessary to ensure proper insertion and optimum compaction of mortar in thin joints.
  - B. Sealant and Sealant Accessories Relief Joints: Comply with requirements of Section 079200 – “Joint Sealants.”
  - C. Scrapers for Removing Mortar: Wood scrapers with rounded corners.
  - D. Brushes for Removing Dirt and Debris from Joints: Stiff natural bristle or fiber bristle brushes. No metal bristle brushes are permitted.

PART 3 – EXECUTION

- 3.1 GENERAL
- A. Examination: Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of work. Do not proceed until unsatisfactory conditions have been corrected.
  - B. Protection: Erect dust impervious barriers and take other measures necessary to prevent dust from traveling beyond work platform before using power grinders, pneumatic chisels, other power tools, or hand methods that generate airborne dust. Before leaving fresh or unfinished work, fully cover and protect wall against rain and wind in an approved manner. Before continuing, brush clean previously laid work.
  - C. Wetting Bricks and Existing Masonry: Thoroughly wet brick and existing masonry prior to installation to ensure that brick and masonry are nearly saturated but free of surface water (saturated, surface dry) when mortar is applied.
  - D. Full Shoved Joints: Ensure that bed, head, and collar joints in masonry are shoved full so that mortar fully contacts all surfaces of masonry units in joints and there are no voids in brickwork. Do not slush joints.

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3.2 BRICK MASONRY

- A. General: Lay brick plumb, level, and true to line in full beds of mortar with bond pattern matching original bond pattern and courses and joints meeting those of adjacent brick masonry. Provide anchors and ties as indicated on approved shop drawings to ensure solid, stable construction.
- B. Cutting Masonry Units: Where brick are to be cut to size, make cuts neatly with a power-driven saw. Do not expose cut face to weather.
- C. Jointing: Jointing of rebuilt masonry shall match that of existing masonry. Each course shall align with and be flush with existing work. Joints shall be uniform, matching widths of existing joints.
- D. Joints: Fill joints in brickwork completely full with mortar as each course is laid.
  - 1. Bed Joints: Form bed joints in one of the following ways:
    - a. Apply a thick layer of smooth or slightly furrowed mortar on top of units previously laid and shove brick in place.
    - b. Apply a full coat of mortar to bottom of brick and shove it into place.
  - 2. Head and Collar Joints: Form head and collar joints by applying a full coat of mortar to entire end or entire side as case requires and then shoving mortar covered end and/or side of brick tightly against bricks previously laid. Apply 3/8-inch-thick coat of mortar to back of facing brick before brick is installed.
  - 3. Preparation for Pointing Joints in Brick Masonry: Rake joints in exposed brick masonry to prepare for pointing as specified in Article “Joint Preparation, “ below.
- E. Disturbed Masonry Units: Remove masonry units disturbed after laying and relay in fresh mortar. If adjustments are required, remove masonry units and reset in fresh mortar; do not pound or tap masonry units to adjust.
- F. Damaged Masonry Units: Remove and replace brick that are loose, chipped, broken, stained or damaged by freezing or for any other reason, and units that do not match adjoining units as intended. Furnish new units to match adjoining units and install in fresh mortar, pointed to eliminate evidence of replacement.

3.3 REPLACING DAMAGED, DETERIORATED

- A. General: Replace damaged and deteriorated brick with salvaged brick or new brick where salvaged brick is not available to match original in size, color, surface texture, light reflectance, and other physical properties.
- B. Removal: Carefully remove brick to be replaced and mortar from joints around it. Do not disturb adjacent brick. In each case where bond of brick is broken, remove brick and mortar around brick and reset brick.
- C. Cleaning: Thoroughly remove dirt and dust from hole. Use care to ensure debris is not deposited in holes previously cleaned.
- D. Wetting: Thoroughly wet brick to be inserted and surfaces at hole in masonry to receive brick to ensure that masonry is nearly saturated but surface dry at time of installation.

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- E. Inserting Brick: Apply mortar to all surfaces in hole to receive replacement brick and to all surfaces of brick to be inserted, except for surfaces to be exposed, to ensure that voids are filled with mortar. Excess mortar shall be squeezed out of joints around brick as it is inserted.
  - 1. Anchor bricks with brick ties placed at no less than one tie every 2.67 sq. ft.
- F. Preparation and Pointing: Rake joints to prepare for pointing. Point joints following requirements of Articles “Mortar Application” and “Joint Tooling,” below.

### 3.4 REMOVING ABANDONED ANCHORS AND PATCHING HOLES

- A. General: Remove abandoned anchors as indicated and patch holes to match adjacent surface.
  - 1. If anchor hole extends across joint, provide two patches, one on either side of joint, and point joint to comply with requirements of Section 04 05 13.91 – “Masonry Pointing.” Do not patch across joint.
- B. Carefully remove anchors by drilling with a rotary drill using a sharp masonry bit or masonry core bit 1/8 inch larger in diameter than existing hole. Do not use hammer drill. Do not damage adjacent masonry or chip edges of drill hole.
- C. Clean hole to remove dirt and loose debris.
- D. Wet masonry around hole to ensure that brick will not rapidly draw water from patching mortar.
- E. Fill hole with custom patching mortar matching color of adjacent brick surface. Finish surface in plane of adjacent surface. Tool surface to match texture of adjacent brick.

### 3.5 PREPARING AND POINTING JOINTS

- A. Preparing Joints Containing Mortar
  - 1. General: Remove mortar from joints to a depth of 3/4 inch, to 2-1/2 times width of joint, or to sound mortar, whichever is deepest. In all cases remove deteriorated, weathered, and loose material to sound mortar.
    - a. Completely remove mortar from surfaces of masonry units adjoining joint to allow new mortar to bond directly with masonry units.
    - b. Cut surface of mortar at rear of joint at a uniform depth from and parallel to wall surface.
    - c. Do not damage faces or arises of masonry units during joint preparation. Cease joint preparation work if, in Architect’s judgment, masonry units are damaged by methods being used to prepare joints. Do not resume work until tools, workers, and methodology have been corrected to ensure that masonry units are not damaged and that work meets standard set by approved mock-up.
  - 2. Mortar Removal in Locations Indicated to Receive Deep Pointing: Remove loose mortar to sound mortar. Use wedges, shims, and/or other approved methods to prevent displacement of masonry units during mortar removal.
  - 3. Mortar Removal Using Hand Tools: Use hand tools for removal of mortar from head joints in brickwork, from other joints in stone and brick masonry that are less than 6 inches long, and from other joints in which use of power tools might damage masonry units. Use hand tools to complete mortar removal from joints where power tools have been used to partially remove mortar.



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- a. For narrow joints of 1/8-inch or less in width, rake mortar from joints manually with a sharp knife blade or cutter made for this purpose. Cutter may be used with or without aid of a hammer.
- b. Sharpen chisels as often as necessary to provide for optimum cutting of mortar and to minimize chipping but at least hourly.

4. Mortar Removal Using Power Tools

- a. Demonstrated Ability of Mechanics: Prior to beginning work, demonstrate that workers using power tools are proficient in use of power tools for joint preparation. Failure to demonstrate to Architect's satisfaction that each worker is proficient in the use of each type of power tool proposed for use and that power tool joint preparation does not result in damage to masonry units shall result in prohibition of use of power tools for joint preparation. If proficiency is not demonstrated, or if work in progress results in damage to masonry to remain, power tool work shall cease, and joints shall be prepared for pointing using only hand-powered tools.
- b. Rotary Power Tools: With Architect's specific prior approval following successful demonstrations of skill by mechanics, power grinders and/or pneumatic grinders may be used to partially remove mortar from horizontal (bed) joints in brick masonry and from joints longer than 6 inches in stone masonry where there is no danger of cutting into adjacent masonry units.
  - 1). Limitations on Use of Electric Power Grinders: Do not use electric power grinders on joints less than 3/16-inch wide or less than 6 inches long or where ornament, elaborate profile, or other surface irregularity might make damage to masonry units likely.
  - 2). Limitations on Use of Modified Pneumatic Die Grinders: Do not use modified pneumatic die grinders with custom thin blades on joints less than 1-1/2 times the width of the grinder blade.
  - 3). Extent of Mortar Removal Using Power Grinders: Use power grinder only to score one kerf cut in center of each joint to depth of mortar removal required. Remove remaining mortar from sides of joint using hand tools or, if approved, pneumatically powered chisels.
    - a) Stop kerf at least 4 inches from inside corners and projecting elements. Remove remaining mortar using hand tools or pneumatically powered chisels.
  - 4). Jigs: Construct jigs to guide and limit power tools as necessary to prevent damage to adjacent masonry units.
- c. Pneumatic Heads with Chisels: With Architect's specific prior approval following successful demonstrations of skill by mechanics, pneumatically powered chisels may be used to remove mortar from joints in place of hand tools. If work using pneumatically powered chisels results in damage to masonry to remain, work using pneumatic chisels shall cease, and joints shall be prepared using hand tools or other approved methods that do not result in damage to masonry units.
- d. Reciprocating Brick and Mortar Saw: With Architect's specific prior approval following successful demonstrations of skill by mechanics, a reciprocating saw specifically designed for removal of mortar from joints in masonry may be used to partially remove mortar from joints 3/8-inch wide or wider where there is no danger of cutting into adjacent masonry units. If work using reciprocating brick and mortar saw results in damage to masonry to remain, work using reciprocating

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- brick and mortar saw shall cease, and joints shall be prepared using hand tools or other approved methods that do not result in damage to masonry units.
- e. Hand-Held Multipurpose Oscillating Tool with Diamond Blades: With Architect's specific prior approval following successful demonstrations of skill by mechanics, a hand-held multipurpose oscillating tool with diamond blades may be used to partially remove mortar from joints where there is no danger of cutting into adjacent masonry units. If work using multipurpose oscillating tool results in damage to masonry to remain, work using multipurpose oscillating tool shall cease, and joints shall be prepared using hand tools or other approved methods that do not result in damage to masonry units.
4. Cleaning: Remove loose mortar and foreign material from raked joints using a fine, stiff natural- or synthetic-fiber bristle brush. Remove remaining particles, dust, and dirt. Ensure that dust and dirt are not blown back into previously cleaned joints.
  5. Restoration and Replacement of Damaged Units: Repair and/or replace masonry units damaged during joint preparation to provide units in at least as good a condition as before joint preparation was begun to the satisfaction of Architect or Owner at no additional cost to Owner.
- B. Preparing Joints Containing Sealant
1. General: Remove sealant and sealant residue from joints using mechanical methods, solvent cleaner, and abrasive methods as required to provide clean masonry substrates suitable for optimum adhesion and performance of mortar without damaging faces of masonry units.
  2. Mechanical and Chemical Removal of Sealant and Sealant Residue: Remove as much of the sealant as possible using mechanical means and remove remaining sealant and sealant residue from joint substrates using approved chemical remover following requirements of Section 040110 – "Masonry Cleaning."
  3. Abrasive Treatment of Substrate: Following protection of surfaces of masonry units to be exposed in completed work sufficient to prevent them from being damaged by abrasive removal of material from joints, use wire bristle brushes, metal scrapers, small grinders, low-pressure, airborne-abrasive blasting, or other approved method to remove remaining traces of sealant from joint substrates and to prepare joint substrates for optimum installation of mortar. Do not damage surfaces of masonry units to be exposed in finished work in any way. Do not widen joints.
  4. Cleaning: Thoroughly remove dust and debris. Use care to ensure debris is not deposited in joints previously cleaned.
  5. Removal of Mortar Behind Sealant: If removal of sealant leaves a joint with mortar closer than 3/4 inch or 2-1/2 times joint width, whichever is greater, to the face of the masonry or with loose or deteriorated mortar, remove mortar to comply with requirements of Paragraph "Preparing Joints Containing Mortar," above.
- C. Pointing Joints
1. Wetting: Thoroughly drench masonry with water 24 hours prior to pointing joints. Thoroughly wet masonry again immediately before pointing joints and allow surfaces to dry slightly. At time of masonry pointing, surfaces shall be damp, so that they do not rapidly absorb moisture, but free of standing water (saturated, surface dry).
  2. Masonry Pointing: Point joints as follows.
    - a. Using a long, thin masonry pointing trowel, tightly pack mortar into joints in layers not exceeding 1/4-inch thick to fill joint to match original sound joints.

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- b. Begin by filling areas from which mortar is missing to a depth greater than 3/4 inch in 3/8-inch-thick layers to within 3/4 inch of finished joint surface to provide a uniform substrate for final masonry pointing. Fill final 3/4-inch depth of joint continuously and uniformly in 1/4-inch-thick layers.
- c. Firmly iron each layer to compact mortar and ensure full bond between mortar and masonry units and a firm, solid joint.
- d. Allow each layer to reach leather hardness before applying succeeding layer. Do not let previous layer dry out before applying succeeding layer. Construct uniform joints.
- e. Do not spread mortar over edges onto exposed surfaces of masonry units. Do not feather edge mortar.
- f. When stopping work at end of each day or for other reasons, stagger layers of mortar so that there will be no through joints in mortar inserted into joints. Stagger joints in layers so that they are at least 3 inches from each other.
- g. Where applying new work to that of a prior day, dampen previous work to ensure good bond.

3. Joint Tooling

- a. Tooling: After final layer of mortar is “leather hard,” tool joints with a flat rule jointer, or as directed by Architect.
- b. Profile: Tool joints to profile as shown on Drawings or to match original joint profiles as directed by Architect. Solidly compress mortar so that it adheres well to masonry on both sides and forms a dense surface. Premature or late tooling will result in unacceptable finishes, which will be rejected.

4. Curing

- a. Keep newly pointed joints damp for at least 72 hours after mortar has been inserted. Do not apply a direct stream of water to joints for at least 7 days after mortar has been placed.
- b. Ensure masonry temperature remains as required by specifications until mortar is thoroughly cured.

D. Cleaning and Repair of Mortar Joints

- 1. Water Washing: Wash pointed masonry with clean filtered water and nonabrasive hand tools to remove mortar debris from masonry surfaces. Do not use chemical cleaners.
  - a. Wash within 72 hours after completion of masonry pointing.
  - b. Use blunt-edged wood scrapers, soft natural bristle brushes, and rough towels along with water to remove mortar debris. Do not use wire brushes. Do not scratch joint surfaces.
  - c. Stop cleaning masonry unit surfaces free of misapplied mortar if methods and materials used damage pointed joints. Do not resume cleaning masonry free of misapplied mortar until methods and materials have been changed to avoid damage to mortar in joints.
- 2. Repair of Pointed Joints: As cleaning progresses, examine joints to locate cracks, holes, and other defects. Carefully point up and fill such defects with mortar. Where joints are defective in opinion of Architect or authorized Owner’s Representative cut out joints to minimum depth of 3/4 inch, or two-and-one-half times joint width, whichever is greater; properly prepare joint substrates; and provide new pointing mortar exercising extreme care to ensure that color matches that of adjacent masonry pointing work. Exposed joint surfaces shall be free from protruding mortar, holes, pits, depressions, and other defects.

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3.7 ADJUST AND CLEAN

- A. Clean masonry prior to final setting of mortar. Remove mortar and stains from face of brickwork with dry, stiff bristle brushes. Architect or authorized Owner's Representative may require additional cleaning procedures if masonry staining occurs. Keep walls clean as work progresses. After mortar has cured, perform final cleaning, using only clean water and stiff fiber bristle brushes.
- B. Clean mortar joints as specified in Paragraph "Cleaning and Repair of Mortar Joints," above.

3.8 CORRECTIVE MEASURES

- A. Correct all work of this Section that does not meet requirements of this Specification to Architect or Owner satisfaction at no cost to the Owner.

END OF SECTION

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SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Lintels.
3. Brick.
4. Mortar and grout materials.
5. Reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Accessories.
9. Mortar and grout mixes.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in unit masonry.
2. Steel lintels in unit masonry.

C. Related Requirements:

1. Section 014339 "Mockups" for integrated exterior mockup requirements.
2. Section 019119.43 "Exterior Enclosure Commissioning."
3. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product.

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C. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Weep/cavity vents.
3. Cavity drainage material.
4. Accessories embedded in masonry.

E. Sustainable Design Submittals:

1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
2. Environmental Product Declaration (EPD): For each product.
3. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
4. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
5. Third-Party Certified Life Cycle Assessment: For each product.

1.5 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

B. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

C. Material Certificates: For each type of the following:

1. Masonry units.
  - a. Include data on material properties.
  - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
  - c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.

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- d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing in accordance with ASTM C67/C67M.
- 2. Cementitious materials. Include name of manufacturer, brand name, and type.
  - 3. Mortar admixtures.
  - 4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 5. Grout mixes. Include description of type and proportions of ingredients.
  - 6. Reinforcing bars.
  - 7. Joint reinforcement.
  - 8. Anchors, ties, and metal accessories.
- D. Qualification Statements: For testing agency.
- E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
  - 2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- F. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.
- G. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.
  - 2. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

1.7 MOCKUPS

- A. Sample Panel Mockups: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
  - 1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 60 inches long by 48 inches high by full thickness.
  - 2. Build sample panels facing south.
  - 3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.

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4. Clean one-half of exposed faces of panels with masonry cleaner indicated.
5. Protect approved sample panels from the elements with weather-resistant membrane.
6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
  - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
  2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.



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1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  2. Protect sills, ledges, and projections from mortar droppings.
  3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain masonry units, cementitious mortar components, and mortar aggregate from single source, producer, or manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
1. Determine net-area compressive strength of masonry by testing masonry prisms in accordance with ASTM C1314.

### 2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Do not use masonry units that contain chips, cracks, or other defects.

### 2.4 CONCRETE MASONRY UNITS

- A. Regional Materials: CMUs shall be manufactured within 100 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

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- B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  - 2. Provide square-edged units for outside corners unless otherwise indicated.
- C. CMUs: ASTM C90, normal weight.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4500 psi.
  - 2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
- D. Concrete Building Brick: ASTM C55, normal weight.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4500 psi.
  - 2. Size (Actual Dimensions): 3-5/8 inches wide by 3-5/8 inches high by 7-5/8 inches long.

## 2.5 LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

## 2.6 BRICK

- A. Regional Materials: Brick shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
  - 1. Match existing brick.
- C. Clay Face Brick: Match existing brick.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Acme Brick Company
    - b. Belden Brick Company (The)
    - c. Boral Bricks, Inc; Boral Limited
    - d. Endicott Clay Products Co
    - e. General Shale, Inc.
    - f. Glen-Gery Corporation

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2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength to match existing brick.
3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
4. Surface Coating: Brick with colors or textures produced by application of coatings withstand 50 cycles of freezing and thawing in accordance with ASTM C67/C67M with no observable difference in the applied finish when viewed from 10 ft.
5. Size (Actual Dimensions): Match existing brick.
6. Application: Use where brick is exposed unless otherwise indicated.
7. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.
8. Color and Texture: As selected by Architect.

D. Building (Common) Brick: ASTM C62, Grade NW, Grade MW, or Grade SW.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength to match existing brick.
2. Size (Actual Dimensions): Match existing brick.

## 2.7 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- B. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C91/C91M.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Argos USA LLC
    - b. Cemex S.A.B. de C.V.
    - c. Fairborn Cement Company
    - d. Federal White Cement, Ltd.
    - e. Heidelberg Materials
    - f. Holcim (US) Inc
    - g. Lafarge North America Inc.

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- h. Lehigh White Cement Company
    - i. Quikrete; The QUIKRETE Companies, LLC
    - j. Sakrete; CRH Americas, Oldcastle APG
- F. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime or masonry cement, sand, and admixtures and complying with ASTM C1714/C1714M.
  - 1. Preblended Dry Portland Cement Mortar Mix:
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Amerimix is a trademark of Bonsal American, an Oldcastle company
      - 2) Quikrete; The QUIKRETE Companies, LLC
      - 3) Sakrete; CRH Americas, Oldcastle APG
      - 4) SPEC MIX, LLC
  - 2. Preblended Dry Masonry Cement Mortar Mix:
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Amerimix is a trademark of Bonsal American, an Oldcastle company
      - 2) SPEC MIX, LLC
- G. Aggregate for Mortar: ASTM C144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- H. Aggregate for Grout: ASTM C404.
- I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C or ASTM C1384, and recommended by manufacturer for use in masonry mortar of composition indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
    - b. GCP Applied Technologies Inc.
- J. Water: Potable.

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2.8 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. 3GEN Masonry Products, Inc.
    - b. Heckmann Building Products, Inc.
    - c. Hohmann & Barnard, Inc
    - d. Wire-Bond
- C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
  - 1. Walls: Hot-dip galvanized carbon steel.
  - 2. Wire Size for Side Rods: 0.187-inch diameter.
  - 3. Wire Size for Cross Rods: 0.187-inch diameter.
  - 4. Wire Size for Veneer Ties: 0.187-inch diameter.
  - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
  - 6. Provide in lengths of not less than 10 ft., with prefabricated corner and tee units.
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. 3GEN Masonry Products, Inc.
    - b. Hohmann & Barnard, Inc
    - c. Wire-Bond
- E. Masonry-Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch-diameter, hot-dip galvanized carbon steel continuous wire.

2.9 TIES AND ANCHORS

- A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
  - 2. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.

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3. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.
  2. Tie Section: Triangular-shaped wire tie made from 0.25-inch-diameter, hot-dip galvanized steel wire.
- D. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.
- E. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
  2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.1084-inch-thick steel sheet, galvanized after fabrication.
  3. Fabricate wire ties from 0.187-inch-diameter, hot-dip galvanized-steel or stainless steel wire unless otherwise indicated.
  4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
  5. Masonry-Veneer Anchors; Vertical Slotted L-Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting vertical leg with slotted hole for wire tie and washer at face of insulation.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) 3GEN Masonry Products, Inc.
      - 2) FERRO Corporation
      - 3) Hohmann & Barnard, Inc
      - 4) PROSOCO, Inc
      - 5) Wire-Bond
  6. Masonry-Veneer Anchors; Slotted Plate with Prongs: Sheet metal anchor section, with screw holes at top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation; and raised rib-stiffened strap, stamped into center to provide a slot between strap and base for wire tie. Use self-adhering tape to seal penetration behind anchor plate.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hohmann & Barnard, Inc

2) Wire-Bond

2.10 EMBEDDED FLASHING

A. Metal Flashing:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Cheney Flashing Company
  - b. Hohmann & Barnard, Inc
  - c. Keystone Flashing Company, Inc
  - d. Wire-Bond
2. General: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
  - a. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
  - b. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 ft.. Provide splice plates at joints of formed, smooth metal flashing.
  - c. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with sawtooth ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
  - d. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
  - e. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  - f. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
  - g. Fabricate metal drip edges and sealant stops for sawtooth metal flashing from plain metal flashing of same metal as sawtooth flashing and extending at least 3 inches into wall with hemmed inner edge to receive sawtooth flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.
  - h. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  - i. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
  - j. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
  - k. Solder metal items at corners.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Fabric Flashing: 7 oz./sq. ft., self-adhesive copper sheet bonded between two layers of glass-fiber cloth.

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- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1) Advanced Building Products Inc.
  - 2) Hohmann & Barnard, Inc
  - 3) STS Coatings, Inc.
  - 4) Wire-Bond
  - 5) York Manufacturing, Inc
2. Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2-mil of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric, to produce an overall thickness of 40-mil.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Fiberweb, a brand of Clark/Hammerbeam Corp.
    - 2) Hohmann & Barnard, Inc
    - 3) STS Coatings, Inc.
    - 4) Wire-Bond
    - 5) York Manufacturing, Inc
3. Self-Adhering, Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2 mil of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric with a permanent, clear adhesive, to produce an overall thickness of 40 mil.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Hohmann & Barnard, Inc
    - 2) STS Coatings, Inc.
    - 3) VaproShield LLC
    - 4) Wire-Bond
    - 5) York Manufacturing, Inc
  - b. Applications: Use 10-mil-thick flashing at windows, doors, and small wall penetrations; not at base of walls. Use 40-mil-thick flashing at base of walls.
4. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 40 mil.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Advanced Building Products Inc.
    - 2) Carlisle Coatings & Waterproofing Inc



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- 3) Fiberweb, a brand of Clark/Hammerbeam Corp.
      - 4) GCP Applied Technologies Inc.
      - 5) Heckmann Building Products, Inc.
      - 6) Hohmann & Barnard, Inc
      - 7) Polyguard Products, Inc.
      - 8) W. R. Meadows, Inc
      - 9) Williams Products, Inc.
      - 10) Wire-Bond
      - 11) York Manufacturing, Inc
    - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
  5. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hohmann & Barnard, Inc
      - 2) Hyload; IKO Industries, Inc.
      - 3) Mortar Net Solutions
      - 4) Wire-Bond
    - b. Monolithic Sheet: Elastomeric thermoplastic flashing, 40 mil thick.
    - c. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 25 mil thick, with a 15-mil-thick coating of adhesive.
    - d. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
  6. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 40 mil thick.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Carlisle Coatings & Waterproofing Inc
      - 2) Elevate; Holcim Building Envelope
      - 3) Heckmann Building Products, Inc.
      - 4) Hohmann & Barnard, Inc
      - 5) Wire-Bond
- C. Drainage Plane Flashing: Fabricate from stainless steel and drainage membrane to shapes indicated, including weep tabs, termination bar, and drip edge. Provide flashing materials as follows:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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- a. Mortar Net Solutions
  - b. STS Coatings, Inc.
  - c. York Manufacturing, Inc
2. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
  3. Fabricate continuous flashings in sections 60 inches long, minimum.
  4. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

2.11 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vents: Use one of the following unless otherwise indicated:
1. Wicking Material: Absorbent rope, made from cotton, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity. Use only for weeps.
  2. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by 4 inches long.
  3. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches long.
  4. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 1) 3GEN Masonry Products, Inc.
  - 2) Advanced Building Products Inc.
  - 3) Heckmann Building Products, Inc.
  - 4) Hohmann & Barnard, Inc
  - 5) Mortar Net Solutions
  - 6) Wire-Bond

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5. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) CavClear; a division of Archovations, Inc.
      - 2) Hohmann & Barnard, Inc
      - 3) Keene Building Products
      - 4) Mortar Net Solutions
  6. Vinyl Weep Hole/Vent: Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hohmann & Barnard, Inc
      - 2) Williams Products, Inc.
      - 3) Wire-Bond
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Mortar Deflector: Strips, full depth of cavity and 16 inches high, with dimpled surface that prevent clogging with mortar droppings.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Advanced Building Products Inc.
      - 2) Hohmann & Barnard, Inc
      - 3) Keene Building Products
      - 4) Mortar Net Solutions
      - 5) Wire-Bond
      - 6) York Manufacturing, Inc
  2. Rainscreen Drainage Mat: Sheets or strips not less than full depth of cavity thick and installed to full height of cavity, with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity to prevent weep holes from clogging with mortar.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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- 1) Advanced Building Products Inc.
- 2) CavClear; a division of Archovations, Inc.
- 3) Keene Building Products
- 4) Mortar Net Solutions
- 5) Wire-Bond

- F. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Diedrich Technologies, Inc.; a Hohmann & Barnard company
    - b. EaCo Chem, Inc.
    - c. PROSOCO, Inc

2.12 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
  2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
  3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.
1. For reinforced masonry, use Type S.
  2. For interior nonload-bearing partitions, Type N.
- D. Grout for Unit Masonry: Comply with ASTM C476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C476, paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
  3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  - 2. Verify that foundations are within tolerances specified.
  - 3. Verify that reinforcing dowels are properly placed.
  - 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

#### 3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.

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2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

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- C. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
  - 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
  - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay CMUs as follows:
  - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  - 3. Bed webs in mortar in grouted masonry.
  - 4. Fully bed entire units, including areas under cells, at starting course on walls where cells are not grouted.
  - 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

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- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush where indicated to receive waterproofing air barriers unless otherwise indicated.

### 3.6 COMPOSITE MASONRY

- A. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.
  - 1. Provide continuity with masonry-joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.
- B. Intersecting and Abutting Walls: Unless vertical expansion or control joints are indicated at juncture, bond walls together as follows:
  - 1. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.

### 3.7 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:
  - 1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
  - 2. Embed connector sections and continuous wire in masonry joints.
  - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  - 4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
  - 5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
  - 6. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.
- B. Provide not less than 2 inches, or as indicated on Drawings, of airspace between back of masonry veneer and face of insulation.
  - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.



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3.8 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1. Space reinforcement not more than 16 inches o.c.
  - 2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.9 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
  - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
  - 2. Install preformed control-joint gaskets designed to fit standard sash block.
  - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
  - 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints in brick as follows:
  - 1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
  - 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
  - 3. Build in compressible joint fillers where indicated.
  - 4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.
  - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

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3.10 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where indicated and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
  - 3. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.
  - 4. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under water-resistive barrier or air barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
  - 5. At lintels and shelf angles, extend flashing 6 inches minimum, to edge of next full unit at each end. At heads and sills, extend flashing 6 inches minimum, to edge of next full unit and turn ends up not less than 2 inches to form end dams.
  - 6. Interlock end joints of sawtooth sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 7. Install metal drip edges and sealant stops with sawtooth sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 8. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.

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9. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
  10. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.
- E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
1. Use specified weep/cavity vent products or open-head joints to form weep holes.
  2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
  3. Space weep holes 24 inches o.c. unless otherwise indicated.
  4. Space weep holes formed from wicking material 16 inches o.c.
  5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
  6. Trim wicking material flush with outside face of wall after mortar has set.
- F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches, to maintain drainage.
1. Fill cavities full height by placing pea gravel in cavities as masonry is laid, so that at any point, masonry does not extend more than 24 inches above top of pea gravel.
- G. Place cavity drainage material in cavities or airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.
- H. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products or open-head joints to form cavity vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.12 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

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2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  2. Limit height of vertical grout pours to not more than 60 inches.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level 2 in TMS 402.
  1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.
- F. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for compressive strength.
- G. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.
- H. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 28 days.

3.14 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

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- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
  - 7. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

3.15 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Masonry Waste Recycling: Return broken CMUs to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 042500 - MANUFACTURED STONE MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
  - 1. Calcium silicate masonry units (CSMU).
  - 2. Mortar and grout.
  - 3. Ties and anchors.
  - 4. Embedded flashing.
- B. Related Sections include the following:
  - 1. Division 01 Section "Quality Requirements" for independent testing and inspection agency procedures and administrative requirements.
  - 2. Division 04 Section "Unit Masonry" for cavity wall insulation; coordination with concrete masonry unit and brick masonry assemblies.
  - 3. Division 05 Section "Cold-Formed Metal Framing" for exterior metal stud back-up systems.
  - 4. Division 05 Section "Metal Fabrications" for steel lintels.
  - 5. Division 06 Section "Sheathing" for exterior gypsum board sheathing.
  - 6. Division 07 Sections "Modified Bituminous Sheet Air Barriers" and "Fluid-Applied Membrane Air Barriers" for Air/Vapor Barrier Membranes.
  - 7. Division 07 Section "Joint Sealants" for sealing control and expansion joints in manufactured stone masonry.
  - 8. Division 07 Section "Expansion Control" for exterior expansion/seismic joints.
- C. Products installed, but not furnished, under this Section include the following:
  - 1. Steel lintels and shelf angles for manufactured stone masonry, furnished under Division 05 Section "Metal Fabrications."
  - 2. Manufactured reglets manufactured stone masonry in masonry joints for metal flashing, furnished under Division 07 Section "Sheet Metal Flashing and Trim."
  - 3. Sealant joints for sealing control and expansion joints in manufactured stone masonry furnished under Division 07 Section "Joint Sealants."

1.3 DEFINITIONS

- A. CSMU(s): Calcium Silicate Masonry Unit(s).

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- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths ( $f'_m$ ) at 28 days.
- B. Determine net-area compressive strength ( $f'_m$ ) of masonry by testing masonry prisms according to ASTM C 1314.

1.5 SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- D. Samples for Initial Selection: For the following:
  - 1. Manufactured stone samples of manufacturer’s full line and range(s).
  - 2. Colored mortar.
- E. Samples for Verification: For each type and color of the following:
  - 1. For each type indicated. Include at least four samples in each set for each type of manufactured stone product, exhibiting the full range of color and other visual characteristics expected in completed Work. Samples will establish the standard by which stone provided will be judged.
  - 2. For each color of mortar required.
  - 3. Special manufactured stone shapes.
  - 4. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
- F. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
  - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- G. Qualification Data: For testing agency.

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- H. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
  - 1. Manufactured stone units.
    - a. Include material test reports substantiating compliance with requirements.
    - b. For manufactured stone, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    - c. For manufactured stone, include material test report for efflorescence according to ASTM C 67.
  - 2. Cementitious materials. Include brand, type, and name of manufacturer.
  - 3. Joint reinforcement.
  - 4. Anchors, ties, and metal accessories.
- I. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.
  - 1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
- J. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Manufactured Stone Masonry: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. Preconstruction Testing Service: Contractor shall engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by the Contractor. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
  - 1. Prism Test: For each type of construction required, per ASTM C 1314.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build stand-alone mockups for each type of exposed manufactured stone masonry construction, and each typical exterior wall, construction and back-up materials in sizes



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approximately 72 inches long by 64 inches high by full thickness, including face and backup wythes and accessories.

- a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
  - b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
  - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
  - d. Include metal studs, sheathing, air barriers, cavity wall insulation, veneer anchors, flashing, and weep holes in exterior masonry-veneer wall mockup.
2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
  3. Protect accepted mockups from the elements with weather-resistant membrane.
  4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store manufactured stone masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

- A. Protection of Manufactured Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

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2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  2. Protect sills, ledges, and projections from mortar droppings.
  3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  1. Basis-of-Design: Subject to compliance with requirements, provide the named product or a comparable product.

### 2.2 MANUFACTURED STONE MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

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2.3 CALCIUM SILICATE MASONRY UNITS (CSMUs)

- A. Calcium Silicate Masonry Units (CSMUs): To ASTM C73, Grade SW; solid units having been pressure formed and autoclaved; 3-5/8-inch bed depth; modular sizes as indicated below; dressed/smooth finish on exposed faces and ends; special shapes as indicated; and having the following properties when tested to the identified standard:
1. Compressive Strength: 6600 psi, to ASTM C170.
  2. Absorption: 8.8 percent, to ASTM C97.
  3. Density: 129 lbs/ft<sup>3</sup>, to ASTM C97.
  4. Modulus of Rupture: 770 psi, to ASTM C99.
  5. Modular Sizes:
    - a. 2-5/16" high, 3-5/8" + 1/4" bed, various lengths up to 23-5/8".
    - b. 4-15/16" high, 3-1/4" + 1/4" bed, various lengths up to 31-5/8".
    - c. 7-5/8" high, 3-3/4" bed, various lengths up to 23-5/8".
  6. Color: As selected by Architect from manufacturer's full range of color pallets.
  7. Basis-of-Design Product: "Shadow Stone® Building Stone," Arriscraft, Int.
- B. Fabricate calcium silicate masonry units (CSMU) to the following tolerances:
1. Unit Length: plus or minus 1/16 inch.
  2. Unit Height: plus or minus 1/16 inch.
  3. Deviation from Square: plus or minus 1/16-inch, with measurement taken using the longest edge as the base.
  4. Bed Depth: plus or minus 1/8-inch.
  5. Custom Dimensions: plus or minus 1/8-inch.
  6. Unit Face Deviations: plus or minus 3/8-inch.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Available Products:
    - a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
    - b. Davis Colors; True Tone Mortar Colors.
    - c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.

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E. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

F. Water: Potable.

2.5 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
  - a. Structural Performance Characteristics: Capable of withstanding a 100-lbfload in both tension and compression without deforming or developing play in excess of 0.05 inch.
2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
  - a. Basis-of-Design Product: Provide “HB-200 Adjustable Veneer Anchor,” Hohmann & Barnard Products, Inc., or subject to compliance with requirements and to accommodate 3-1/2 inches of rigid insulation and 1-1/2 inch air space, provide a comparable product by one of the following manufacturers:
    - 1) Dayton Superior Corporation, Dur-O-Wal Division
    - 2) Heckmann Building Products Inc.
    - 3) Wire-Bond.

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- b. Anchor Section: Rib-stiffened, L-shaped, sheet metal plate with screw holes top and bottom, with projecting legs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
  - c. Fabricate sheet metal anchor sections and other sheet metal parts from 1.05-inch-thick, steel sheet, galvanized after fabrication.
  - d. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch-diameter, hot-dip galvanized steel wire.
3. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange with not less than 3 exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

## 2.6 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
- 1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
  - 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
  - 3. Fabricate through-wall metal flashing embedded in masonry from stainless steel.
  - 4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
- B. Flexible Flashing: Use the following unless otherwise indicated:
- 1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch.
- C. Application: Unless otherwise indicated, use the following:
- 1. Where flashing is indicated to receive counterflashing, use metal flashing.
  - 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
  - 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use flexible flashing with a metal drip edge.
  - 4. Where flashing is fully concealed, use flexible flashing.

## 2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

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- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use one of the following, unless otherwise indicated:
  - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
  - 2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
  - 3. Aluminum Weep Hole/Vent: One-piece, L-shaped units made from sheet aluminum, designed to fit into a head joint and consisting of a vertical channel with louvers stamped in web and with a top flap to keep mortar out of the head joint; painted before installation to comply with Division 09 painting Sections in color approved by Architect to match that of mortar.
  - 4. Vinyl Weep Hole/Vent: One-piece, offset, T-shaped units made from flexible, injection-molded PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color approved by Architect to match that of mortar.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Provide one of the following configurations:
    - a. Strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.
    - b. Strips, not less than 1-1/2 inches thick and 10 inches wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
  - 2. Available Manufacturers:
    - a. Advanced Building Products Inc.
    - b. Archovations, Inc.
    - c. Dayton Superior Corporation, Dur-O-Wal Division.
    - d. Mortar Net USA, Ltd.
    - e. Sandell, Inc.

## 2.8 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
  - 3. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement, mortar cement, and lime.

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- B. Mortar for Manufactured Stone Masonry: Comply with ASTM C 270, Property Specification. Proportion Specification, 1 part Portland cement, 1 part hydrated lime, 6 parts mortar aggregate by volume for both cementitious material and sand aggregate; integral color as selected by Architect. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
  - 1. For exterior, above-grade, non-load-bearing walls and parapet walls; and for other applications where another type is not indicated, use Type N.
- C. Pigmented Mortar: Use colored cement product[ or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
  - 1. Pigments shall not exceed 10 percent of portland cement by weight.
  - 2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
- D. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

## 2.9 SOURCE QUALITY CONTROL

- A. Contractor shall engage a qualified independent testing agency to perform source quality-control testing indicated below:
  - 1. Payment for these services will be made by the Contractor.
  - 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- B. Manufactured Stone Masonry Unit Test: For each type of unit furnished, per ASTM C 67.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
  - 2. Verify that foundations are within tolerances specified.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, pre-soak units, cut units with motor-driven wet-saw; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
  - 1. Mix units from several pallets or cubes as they are placed.
- E. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
  - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
  - 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
  - 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
  - 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
  - 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in coursed ashlar running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.



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- C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay manufactured stone masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

### 3.5 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
  - 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft. of wall area spaced not to exceed 16 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
    - a. Use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- C. Coat cavity face of masonry backup wall systems to comply with Division 07 Section "Modified Bituminous Sheet Air Barriers" and "Fluid Applied Membrane Air Barriers."
- D. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
  - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

### 3.6 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and masonry backup with masonry-veneer anchors to comply with the following requirements:
  - 1. Fasten screw-attached anchors through sheathing to wall framing and to masonry backup with metal fasteners of type indicated.
  - 2. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of insulation.
  - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  - 4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally, with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

### 3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in manufactured stone masonry using one of the following methods:
  - 1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
  - 2. Install preformed control-joint gaskets designed to fit standard sash block.
  - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
  - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints in manufactured stone masonry as follows:
  - 1. Build flanges of factory-fabricated, expansion-joint units into masonry.
  - 2. Build in compressible joint fillers where indicated.
  - 3. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.
  - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### 3.8 LINTELS

- A. Install steel lintels where indicated.

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- B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.9 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows, unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches.
  - 3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  - 4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
- C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
  - 1. Use specified weep/vent products to form weep holes.
  - 2. Space weep/vent holes 24 inches o.c., unless otherwise indicated.
- D. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches, to maintain drainage.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.
- F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
  - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: The Contractor will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

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- B. Inspections: Level 1 special inspections according to the “International Building Code.”
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- C. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
  - 1. Payment for these services shall be made by the Contractor.
  - 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Manufactured Stone Masonry Unit Test: For each type of unit provided, per ASTM C 67.
- F. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.
- G. Prism Test: For each type of construction provided, per ASTM C 1314 at 7 days and at 28 days.
- H. Daily Masonry Inspection:
  - 1. All reinforced masonry shall be inspected by an independent testing agency engaged by the Contractor, daily, subject to the following:
    - a. Masonry shall be laid up in accordance with the Contract Documents with special attention placed upon location of all reinforcing, embedded items, and control joints. All masonry construction shall be in conformance with the following. The Contractor shall be responsible for obtaining a copy, which is to be kept on site and available for use, for the duration of the project. Masonry Inspector shall be on site a minimum of 2 hours per day and whenever grouting of CMU cores occurs.
      - 1) ACI 530-02/ASCE 5-02/TMS 402-02 (Building Code Requirements for Masonry Structures & Commentary).
      - 2) CI 530.1-02/ASCE 6-02/TMS 602-02 (Specification for Masonry Structures & Commentary).
    - b. Prior to grouting operation, the Masonry Inspector shall examine all masonry work to determine that cores are free of debris and cold/hot weather protection is in place. Review all mortar joints for lack of bond particularly at head joints and repoint as required. All masonry in place and stocked on-site shall be examined for damage and excessive moisture. All masonry to be dry prior proceeding. Results of this review are to be kept in a daily report. No work is to be constructed on masonry with discrepancies until they have been resolved.
    - c. The Masonry Inspector shall examine work in progress for quality of workmanship as well as the following specifics:
      - 1) Cores to be grouted shall be kept free of debris, insulation, and mortar droppings. All cores shall be inspected prior to grouting.

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- 2) All vertical reinforcing shall be lapped as indicated and held in place by re-bar positioners such as AA225 as manufactured by AA Wire Products Company, spaced at a maximum of 98 diameters.
  - 3) Walls shall be constructed in a manner to prevent horizontal migration of grout. No non-cementitious materials are to be used for this purpose.
  - 4) Clean-outs are to be provided at the bottom course and courses over bond beams and lintels at all cores that are to be reinforced and high-lift grouted. Provide clean-outs to access vertical reinforcing when threading it through the re-bar positioners.
  - 5) All cores that are to be grouted are to be examined for cleanliness and correct positioning of reinforcing.
  - 6) All high-lift or low-lift grouting procedures are to be followed, particularly vibration compacting of the grout for high-lift grouting which shall be performed five (5) minutes after grout placement.
  - 7) All horizontal joint reinforcing and bond beam reinforcing to be installed as shown on Contract Documents.
  - 8) All bonding of intersecting walls or installation of Z bars to be in accordance with Contract Documents.
  - 9) Embedment of items that will result in excessive interruption of masonry or require the cutting and/or relocation of any reinforcing shall be brought to the attention of the Structural Engineer of Record for review and determination of any additional requirements.
  - 10) All deficiencies as well as remedial procedures employed shall be noted in the daily record.
- d. At the end of daily construction, the Masonry Inspector shall examine all masonry work as constructed to determine that it is in accordance with the Contract Documents, that cores are free of debris and cold/hot weather protection is in place. All masonry in place and stocked on site shall be protected is in place. Results of this review are to be kept in the daily report, copies of which are to be distributed to the Architect and Structural Engineer of Record via Fax, daily.
- e. Masonry constructed without the performance of the required daily inspection shall not be accepted and shall be removed and replaced at no additional cost to the Owner.

3.11 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

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1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone, brick, concrete masonry units, and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape as recommended by the manufacturer.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with 1 tsp. trisodium phosphate, 1 tsp. household detergent/4 cups clean water applied stiff fiber according to manufacturer's written instructions.

3.12 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  1. Crush masonry waste to less than 4 inches in each dimension.
  2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earth Moving."
  3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

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SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trim units.
2. Decorative elements.
3. Mortar materials.
4. Accessories.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product.

1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Sustainable Design Submittals:

1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
2. Environmental Product Declaration (EPD): For each product.
3. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
4. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
5. Third-Party Certified Life Cycle Assessment: For each product.

D. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

E. Samples for Initial Selection: For colored mortar.

F. Samples for Verification:

1. For each color and texture of cast stone required, 4 inches square in size.
2. For each trim shape required, 4 inches in length.

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3. For colored mortar, make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.

G. Full-Size Samples: For each color, texture, and shape of cast stone unit required.

1. Make available for Architect's review at Project site.
2. Make Samples from materials to be used for units used on Project immediately before beginning production of units for Project.
3. Approved Samples may be installed in the Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For manufacturer and testing agency.
  1. Include copies of material test reports, indicating compliance of cast stone with ASTM C1364.
- C. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C1364.
  1. Provide test reports based on testing within previous six months.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by CSI.
- B. Furnish cast stone for installation in mockups specified in Section 042000 "Unit Masonry."
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
  1. Build mockup for windowsill and column cap installation including accessories.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.
- B. Pack, handle, and ship cast stone units in suitable packs or pallets.



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1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.
  2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.6 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations for Cast Stone: Obtain cast stone units from single source from single manufacturer.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

2.2 CAST STONE MATERIALS

- A. General: Comply with ASTM C1364.
- B. Portland Cement: ASTM C150/C150M, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C114. Provide natural color or white cement as required to produce cast stone color indicated.
- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C33/C33M; gradation and colors as needed to produce required cast stone textures and colors.
- D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C33/C33M, gradation and colors as needed to produce required cast stone textures and colors.

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- E. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
- F. Admixtures: Use only admixtures specified or approved in writing by Architect.
  - 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
  - 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
  - 3. Air-Entraining Admixture: ASTM C260/C260M. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.
  - 4. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  - 5. Water-Reducing, Retarding Admixture: ASTM C494/C494M, Type D.
  - 6. Water-Reducing, Accelerating Admixture: ASTM C494/C494M, Type E.
- G. Reinforcement:
  - 1. Deformed steel bars complying with ASTM A615/A615M, Grade 40. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.
    - a. Epoxy Coating: ASTM A775/A775M.
    - b. Galvanized Coating: ASTM A767/A767M.
  - 2. Plain-Steel, Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
  - 3. Galvanized-Steel, Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.
  - 4. Fiber Reinforcement: ASTM C1116/C1116M.
- H. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666, Type 316.

## 2.3 CAST STONE UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advanced Architectural Stone.
- B. Regional Materials: Cast stone units shall be manufactured within 100 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- C. Cast Stone Units: Comply with ASTM C1364.
  - 1. Units are manufactured using the manufacturer's selected method.
  - 2. Trim units including windowsills, copings, and items as indicated on Drawings.

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- D. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
  - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
  - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
  - 3. Provide drips on projecting elements unless otherwise indicated.
- E. Fabrication Tolerances:
  - 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
  - 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
  - 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
  - 4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.
- F. Cure Units as Follows:
  - 1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
  - 2. Keep units damp and continue curing to comply with one of the following:
    - a. No fewer than five days at mean daily temperature of 70 deg F or above.
    - b. No fewer than seven days at mean daily temperature of 50 deg F or above.
- G. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- H. Colors and Textures: As selected by Architect from manufacturer's full range.

## 2.4 MORTAR MATERIALS

- A. Provide mortar materials that comply with Section 042000 "Unit Masonry."
- B. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- C. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- F. Masonry Cement: ASTM C91/C91M.

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Argos USA LLC
  - b. Cemex S.A.B. de C.V.
  - c. Fairborn Cement Company
  - d. Federal White Cement, Ltd.
  - e. Heidelberg Materials
  - f. Holcim (US) Inc
  - g. Lafarge North America Inc.
  - h. Lehigh White Cement Company
  - i. Quikrete; The QUIKRETE Companies, LLC
  - j. Sakrete; CRH Americas, Oldcastle APG
- G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Davis Colors
    - b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
    - c. Lanxess Corporation
    - d. Solomon Colors Inc.
- H. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
  1. Colored Portland Cement-Lime Mix:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Argos USA LLC
      - 2) Heidelberg Materials
      - 3) Holcim (US) Inc
  2. Colored Masonry Cement:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Argos USA LLC
      - 2) Cemex S.A.B. de C.V.
      - 3) Fairborn Cement Company
      - 4) Heidelberg Materials
      - 5) Holcim (US) Inc
      - 6) Lafarge North America Inc.
  3. Formulate blend as required to produce color indicated or, if not indicated, as selected

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- from manufacturer's standard colors.
- 4. Pigments do not exceed 10 percent of portland cement by weight.
- 5. Pigments do not exceed 5 percent of masonry cement or mortar cement by weight.
- I. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime, sand, mortar pigments, water repellents, and admixtures and complying with ASTM C1714/C1714M.
  - 1. Preblended Dry Portland Cement Mortar Mix:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Amerimix is a trademark of Bonsal American, an Oldcastle company
      - 2) Quikrete; The QUIKRETE Companies, LLC
      - 3) Sakrete; CRH Americas, Oldcastle APG
      - 4) SPEC MIX, LLC
  - 2. Preblended Dry Masonry Cement Mortar Mix:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Amerimix is a trademark of Bonsal American, an Oldcastle company
      - 2) SPEC MIX, LLC
- J. Aggregate for Mortar: ASTM C144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
  - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
  - 4. Colored Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- K. Water: Potable.

2.5 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 316 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- B. Dowels: 1/2-inch-diameter round bars, fabricated from Type 316 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Diedrich Technologies, Inc.; a Hohmann & Barnard company
  - b. EaCo Chem, Inc.
  - c. PROSOCO, Inc

2.6 MORTAR MIXES

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.
- B. Do not use admixtures including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  1. Do not use calcium chloride in mortar or grout.
  2. Use portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.
- C. Comply with ASTM C270, Proportion Specification.
  1. For setting mortar, use Type N.
  2. For pointing mortar, use Type N.
- D. Preblended dry mortar mix complying with ASTM C1714/C1714M and capable of producing mortar strength as indicated in ASTM C270.
  1. For setting mortar, use Type N.
  2. For pointing mortar, use Type N.
- E. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
  1. Pigments do not exceed 10 percent of portland cement by weight.
  2. Pigments do not exceed 5 percent of masonry cement or mortar cement by weight.
  3. Mix to match Architect's sample.
  4. Application: Use pigmented mortar for exposed mortar joints.
- F. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
  1. Mix to match Architect's sample.
  2. Application: Use colored-aggregate mortar for exposed mortar joints.

2.7 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C1364.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING CAST STONE IN MORTAR

- A. Set cast stone as indicated in TMS 604.
- B. Install cast stone units to comply with requirements in Section 042000 "Unit Masonry."
- C. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
  - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
  - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- D. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- E. Set units in full bed of mortar with full head joints unless otherwise indicated.
  - 1. Set units with joints 1/4 to 3/8 inch wide unless otherwise indicated.
  - 2. Build anchors and ties into mortar joints as units are set.
  - 3. Fill dowel holes and anchor slots with mortar.
  - 4. Fill collar joints solid as units are set.
  - 5. Build concealed flashing into mortar joints as units are set.
  - 6. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
  - 7. Keep joints at shelf angles open to receive sealant.
- F. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- G. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- H. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- I. Rake out joints for pointing with sealant to depths of not less than 3/4 inch. Scrub faces of units to remove excess mortar as joints are raked.

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- J. Point joints with sealant to comply with applicable requirements in Section 079200 "Joint Sealants."
  - 1. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- K. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
  - 1. Keep joints free of mortar and other rigid materials.
  - 2. Build in compressible foam-plastic joint fillers where indicated.
  - 3. Form joint of width indicated, but not less than 3/8 inch.
  - 4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
  - 5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Set cast stone as indicated in TMS 604.
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
  - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
  - 2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.
- C. Keep cavities open where unfilled space is indicated between back of cast stone units and backup wall; do not fill cavities with mortar or grout.
- D. Fill anchor holes with sealant.
  - 1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- E. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.
- F. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.
  - 1. Form open joint of width indicated, but not less than 3/8 inch.
- G. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- H. Prepare and apply sealant of type and at locations indicated to comply with applicable



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requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/4 inch in 10 ft., or 1/2 inch maximum.
- B. Variation from Level: Do not exceed 1/4 inch in 10 ft., or 1/2 inch maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
  - 1. Remove mortar fins and smears before tooling joints.
  - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
  - 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
  - 5. Clean cast stone by methods described in Cast Stone Institute Technical Bulletin #39.
  - 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION

## SECTION 051200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for steel lintels and miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting requirements.

#### 1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

#### 1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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B. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Anchor rods.
4. Threaded rods.
5. Slide bearings.
6. Shop primer.
7. Galvanized-steel primer.
8. Etching cleaner.
9. Galvanized repair paint.
10. Shrinkage-resistant grout.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
5. Health Product Declaration (HPD): Provide HPD.
6. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

D. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned, high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Identify members not to be shop primed.

E. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

F. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

B. Qualification Data: For fabricator, professional engineer, and testing agency.

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- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Mill test reports for structural-steel materials, including chemical and physical properties.
- F. Product Test Reports: For the following:
  - 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
  - 2. Direct-tension indicators.
  - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
  - 4. Shear stud connectors.
- G. Survey of existing conditions.
- H. Source quality-control reports.
- I. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
  - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds are to pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G are to be considered separate processes for welding personnel qualification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.

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3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
  1. ANSI/AISC 303.
  2. ANSI/AISC 341.
  3. ANSI/AISC 360.
  4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
  1. Option 1: Connection designs have been completed and connections indicated on the Drawings.
  2. Option 3 and 3A: Design bracing connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.
    - a. Use Load and Resistance Factor Design or Allowance Strength Design; data are given at service-load level.
- C. Construction: Combined system of braced frame and masonry shear walls.

### 2.2 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A992/A992M.
- C. Channels, Angles: ASTM A36/A36M.
- D. Plate and Bar: ASTM A36/A36M and ASTM A572/A572M, as indicated.
- E. Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars: ASTM A588/A588M, 50 ksi.
- F. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.

### 2.3 BOLTS AND CONNECTORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex or round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

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1. Finish: Plain.

## 2.4 RODS

- A. Headed Anchor Rods: ASTM F1554, Grade 58, weldable; straight.

1. Nuts: ASTM A563 hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain.

- B. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A63 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Plain.

## 2.5 PRIMER

- A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
2. SSPC-Paint 23, latex primer.
3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

- B. Galvanized-Steel Primer: MPI#26.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: MPI #18.

## 2.6 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.

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5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

## 2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
  1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
  2. Galvanize lintels attached to structural-steel frame and located in exterior walls.

## 2.10 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:

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1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  2. Surfaces to be field welded.
  3. Surfaces of high-strength bolted, slip-critical connections.
  4. Galvanized surfaces unless indicated to be painted.
  5. Corrosion-resisting (weathering) steel surfaces.
  6. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
1. SSPC-SP 2.
  2. SSPC-SP 3.
- C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
  2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, for braced frame connections:
    - a. Ultrasonic Inspection: ASTM E164.
  4. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.



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1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  1. Set plates for structural members on wedges, shims, or setting nuts as required.
  2. Weld plate washers to top of baseplate.
  3. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
  - 1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  - 2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

### 3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
  - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
  - 2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

### 3.6 FIELD QUALITY CONTROL

- A. Inspections: Owner will engage an inspector to perform the following inspections:
  - 1. Verify structural-steel materials and inspect steel frame joint details.
  - 2. Verify weld materials and inspect welds.
  - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

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- a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at braced frame locations:

- 1) Ultrasonic Inspection: ASTM E164.

END OF SECTION

## SECTION 053100 - STEEL DECKING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

#### 1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. Composite floor deck.

C. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

D. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Health Product Declaration (HPD): For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Welding certificates.

C. Product Certificates: For each type of steel deck.

D. Test and Evaluation Reports:

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1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
    - a. Power-actuated mechanical fasteners.
  2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.
- E. Field Quality-Control Submittals:
1. Field quality-control reports.
- F. Qualification Statements: For welding personnel and testing agency.
- 1.4 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
1. AWS D1.1/D1.1M.
  2. AWS D1.3/D1.3M.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 COMPOSITE FLOOR DECK

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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1. [ASC Steel Deck; ASC Profiles, LLC.](#)
2. CSM Metal Deck.
3. [Canam Buildings US Inc.; Canam Group Inc.](#)
4. [Cordeck.](#)
5. [DACS, Inc.](#)
6. [Epic Metals Corporation.](#)
7. [Marlyn Steel Decks, Inc.](#)
8. [Miami Metal Deck.](#)
9. [New Millennium Building Systems, LLC.](#)
10. [OEG Building Materials Inc.](#)
11. [Roof Deck, Inc.](#)
12. [Tristate Decking, Inc.](#)
13. [Verco Decking, Inc.; a Nucor company.](#)
14. [Vulcraft Group; Division of Nucor Corp.](#)
15. [Vulcraft/Verco Group; a division of Nucor Corp.](#)

- B. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Profile Depth: 2 inches.
3. Design Uncoated-Steel Thickness: 0.0598 inch.
4. Span Condition: Triple span or more.

## 2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

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- I. Galvanizing Repair Paint: ASTM A780/A780M.
- J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
  - 1. Weld Diameter: 3/4 inch, nominal.
  - 2. Weld Spacing:
    - a. Weld edge ribs of panels at each support. Space additional welds an average of 16 inches apart, but not more than 18 inches apart.

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- b. Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals indicated, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches, with end joints as follows:
  - 1. End Joints: Lapped.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

### 3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
    - a. Field welds will be subject to inspection.
  - 2. Steel decking will be considered defective if it does not pass tests and inspections.
  - 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
    - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.
- C. Prepare test and inspection reports.

END OF SECTION



SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior non-load-bearing wall framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
3. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site or virtually.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Exterior non-load-bearing wall framing.
3. Vertical deflection clips.
4. Single deflection track.
5. Double deflection track.
6. Drift clips.
7. Post-installed anchors.
8. Power-actuated anchors.
9. Sill sealer gasket.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

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D. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

E. Delegated Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

B. Qualification Data: For testing agency.

C. Welding certificates.

D. Product Certificates: For each type of code-compliance certification for studs and tracks.

E. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

F. Research Reports:

1. For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

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1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. AllSteel & Gypsum Products, Inc.
2. CEMCO; California Expanded Metal Products Co.
3. CRACO Mfg., Inc.
4. ClarkDietrich.
5. Consolidated Fabricators Corp.; Building Products Division.
6. Design Shapes in Steel.
7. Formetal Co. Inc. (The).
8. Jaimes Industries, Inc.
9. MBA Metal Framing.
10. MRI Steel Framing, LLC.
11. Marino\WARE.
12. Mill Steel Framing; Mill Steel Company.
13. Olmar Supply, Inc.
14. Quail Run Building Materials, Inc.
15. SCAFCO Steel Stud Company; Stone Group of Companies.
16. State Building Products, Inc.
17. Steel Construction Systems; Stone Group of Companies.
18. Steel Network, Inc. (The).
19. Steeler, Inc.
20. Super Stud Building Products Inc.
21. TELLING Industries.
22. The Mill Steel Co.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Owner will engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated on Drawings.
  2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

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- a. Exterior Non-Load-Bearing Framing: Horizontal deflection of  $1/360$  of the wall height.
3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
  - a. Upward and downward movement of 1-1/2 inches.
5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S240.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Framing Members, General: Comply with AISI S240 for conditions indicated.
- C. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  1. Grade: As required for structural performance.
  2. Coating: G90 or equivalent.
- D. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
  1. Grade: As required for structural performance.
  2. Coating: G90.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  1. Minimum Base-Metal Thickness: As required for structural performance.
  2. Flange Width: As required for structural performance.

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3. Section Properties: As required for structural performance.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  1. Minimum Base-Metal Thickness: As required for structural performance.
  2. Flange Width: As required for structural performance.
- C. Vertical Deflection Clips, Exterior: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. AllSteel & Gypsum Products, Inc.
    - b. CRACO Mfg., Inc.
    - c. ClarkDietrich.
    - d. Marino\WARE.
    - e. SCAFCO Steel Stud Company; Stone Group of Companies.
    - f. Steel Construction Systems; Stone Group of Companies.
    - g. Steel Network, Inc. (The).
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
  1. Minimum Base-Metal Thickness: As required for structural performance.
  2. Flange Width: As required for structural performance.

## 2.5 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  1. Supplementary framing.
  2. Bracing, bridging, and solid blocking.
  3. Web stiffeners.
  4. Anchor clips.
  5. End clips.
  6. Foundation clips.
  7. Stud kickers and knee braces.
  8. Hole-reinforcing plates.
  9. Backer plates.

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2.6 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by mechanically deposition according to ASTM B695, Class 50.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
  - 1. Uses: Securing cold-formed steel framing to structure.
  - 2. Type: Torque-controlled expansion anchor.
  - 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
  - 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20.
- B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

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2.8 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.
  - 3. Fasten cold-formed steel framing members by screw fastening, clinch fastening, or pneumatic pin fastening as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
  - 4. Fasten other materials to cold-formed steel framing by bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

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- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by screw fastening or clinch fastening. Wire tying of framing members is not permitted.
    - a. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: As required for structural performance.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.



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- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deep-leg deflection tracks and anchor to building structure.
  - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
  - 3. Connect vertical deflection clips to infill studs and anchor to building structure.
  - 4. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
  - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
  - 1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.5 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.6 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

### 3.7 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing agency will report test results promptly and in writing to Contractor and Architect.

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- C. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Metal ladders.
3. Elevator pit sump covers.
4. Metal bollards.
5. Abrasive metal nosings, treads, and thresholds.
6. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

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B. Product Data:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.
5. Slotted channel framing.
6. Manufactured metal ladders.
7. Metal bollards.
8. Abrasive metal nosings, treads, and thresholds.

C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Elevator machine beams, hoist beams, and divider beams.
3. Steel shapes for supporting elevator door sills.
4. Shelf angles.
5. Metal ladders.
6. Elevator pit sump covers.
7. Miscellaneous steel trim including steel angle corner guards and steel edgings.
8. Metal bollards.
9. Loose steel lintels.

D. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental product declaration.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  1. Temperature Change: 120 deg F, ambient; material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
- C. Regional Materials: Products shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- D. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.
- E. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
- F. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- G. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  1. Size of Channels: 1-5/8 by 1-5/8 inches.
  2. Galvanized Steel: ASTM A653/A653M, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.
- I. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

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2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless steel fasteners for fastening stainless steel.
  - 2. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- D. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- E. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.
- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

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- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

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- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

## 2.7 METAL LADDERS

- A. General:
  - 1. Comply with ANSI A14.3, except for elevator pit ladders.
  - 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
- B. Steel Ladders:
  - 1. Space siderails 16 inches apart unless otherwise indicated.
  - 2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
  - 3. Rungs: 3/4-inch-diameter, steel bars.
  - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
  - 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
  - 6. Nonslip Surfaces for Steel Ladders: Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) IKG
      - 2) SlipNOT Metal Safety Flooring, division of Traction Technologies Holdings, LLC
  - 7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.



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8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
9. Galvanize and prime exterior ladders, including brackets.
10. Prime exterior ladders, including brackets and fasteners, with zinc-rich primer.

2.8 ELEVATOR PIT SUMP COVERS

- A. Fabricate from 3/16-inch floor plate with four 1-inch-diameter holes for water drainage and for lifting.
- B. Provide steel angle supports unless otherwise indicated.

2.9 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe.
  1. Cap bollards with 1/4-inch-thick, steel plate with flat top.
  2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
  3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch-thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- C. Prime steel bollards with zinc-rich primer.

2.10 ABRASIVE METAL NOSINGS, TREADS, AND THRESHOLDS

- A. Cast-Metal Units: Cast iron, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Safety Tread Co., Inc
    - b. Balco; a CSW Industrials Company
    - c. Barry Pattern & Foundry Co., Inc
    - d. Safe-T-Metal Company, Inc.
    - e. Wooster Products Inc
  2. Source Limitations: Obtain units from single source from single manufacturer.
  3. Cross-hatched nosings, 4 inches wide, with 1/4-inch-thick 1-inch lip, for casting into concrete.
  4. Cross-hatched nosings, 1-1/2 inches wide, 3/8-inch-thick 1-1/2 inch lip, for casting into concrete.

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5. Cross-hatched Treads: Full depth of tread with 3/4-by-3/4-inch nosing, for application over bent plate treads or existing stairs.
  6. Fluted-Saddle-Type Thresholds: 5 inches wide by 1/2 inch high, with tapered edges.
  7. Fluted-Interlocking or -Hook-Strip Thresholds: 5 inches wide by 5/8 inch high, with tapered edge.
  8. Thresholds: Plain-stepped- (stop-) type units, 5 inches wide by 1/2 inch high, with 1/2-inch step.
- B. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Safety Tread Co., Inc
    - b. Amstep Products
    - c. Armstrong Products, Inc
    - d. Balco; a CSW Industrials Company
    - e. Nystrom, Inc.
    - f. Wooster Products Inc
  2. Treads: Square-back units, full depth of tread with 1-3/8-inch lip, for application over existing stairs.
- C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- D. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
1. Provide two rows of holes for units more than 5 inches wide, with two holes aligned at ends and intermediate holes staggered.
- E. Apply bituminous paint to concealed surfaces of cast-metal units.
- F. Apply clear lacquer to concealed surfaces of extruded units.
- 2.11 LOOSE BEARING AND LEVELING PLATES
- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
  - B. Galvanize bearing and leveling plates.
  - C. Prime plates with zinc-rich primer.

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2.12 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.13 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.14 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.15 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with universal shop primers specified in Section 099123 "Interior Painting" unless indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

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2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
  5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
1. Cast Aluminum: Heavy coat of bituminous paint.
  2. Extruded Aluminum: Two coats of clear lacquer.

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3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.
  - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLATION OF METAL LADDERS

- A. Secure ladders to adjacent construction with the clip angles attached to the stringer.
- B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

3.4 INSTALLATION OF METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
  - 1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
  - 1. Embed anchor bolts at least 4 inches in concrete.

3.5 INSTALLATION OF ABRASIVE METAL NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

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3.6 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.7 REPAIRS

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 055113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings and guards attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.
4. Railing gates at the level of exit discharge.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs, railings, and guards.
1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, attachment to CLT panels, blocking for attachment of wall-mounted handrails, and items with integral anchors, that are to be embedded in concrete or masonry.
  2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For metal pan stairs and the following:
1. Shop primer products.
  2. Handrail wall brackets.
  3. Grout.
- C. Sustainable Design Submittals:

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1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental product declaration.
3. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
4. Environmental Product Declaration (EPD): For each product.
5. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
6. Environmental Product Declaration: For each product.
7. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
8. Environmental Product Declaration: For each product.
9. Environmental Product Declaration: For each product.
10. Third-Party Certifications: For each product.
11. Third-Party Certified Life Cycle Assessment: For each product.
12. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

D. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

E. Samples for Verification: For each type and finish of nosing.

F. Delegated Design Submittal: For stairs, railings and guards, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.



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B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
  - a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, railings and guards, including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Uniform Load: 100 lbf/sq. ft.
  2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
  3. Uniform and concentrated loads need not be assumed to act concurrently.
  4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
  5. Limit deflection of treads, platforms, and framing members to  $L/360$  or 1/4 inch, whichever is less.
- C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    - b. Infill load and other loads need not be assumed to act concurrently.

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3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. Component Importance Factor: 1.5.

## 2.2 METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
  1. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
  2. Regional Materials: Products shall be fabricated within 500 miles of Project site from materials that have been extracted, harvested, or recovered within 500 miles of Project site.
  3. Regional Materials: Products shall be fabricated within 500 miles of Project site.
  4. Regional Materials: Products shall be fabricated within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.
- C. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
  1. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
  2. Regional Materials: Products shall be fabricated within 500 miles of Project site from materials that have been extracted, harvested, or recovered within 500 miles of Project site.
  3. Regional Materials: Products shall be fabricated within 500 miles of Project site.
  4. Regional Materials: Products shall be fabricated within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.
  5. Provide galvanized finish where indicated.
- D. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
  2. Regional Materials: Products shall be fabricated within 500 miles of Project site from materials that have been extracted, harvested, or recovered within 500 miles of Project site.
  3. Regional Materials: Products shall be fabricated within 500 miles of Project site.

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4. Regional Materials: Products shall be fabricated within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.
  5. Provide galvanized finish for exterior installations and where indicated.
- E. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.
1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
  2. Regional Materials: Products shall be fabricated within 500 miles of Project site from materials that have been extracted, harvested, or recovered within 500 miles of Project site.
  3. Regional Materials: Products shall be fabricated within 500 miles of Project site.
  4. Regional Materials: Products shall be fabricated within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.
- F. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.
1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
  2. Regional Materials: Products shall be fabricated within 500 miles of Project site from materials that have been extracted, harvested, or recovered within 500 miles of Project site.
  3. Regional Materials: Products shall be fabricated within 500 miles of Project site.
  4. Regional Materials: Products shall be fabricated within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.
- G. Galvanized Steel Sheet: ASTM A653/A653M, G90 coating, either commercial steel, Type B, or structural steel, Grade 33, unless another grade is required by design loads.
1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
  2. Regional Materials: Products shall be fabricated within 500 miles of Project site from materials that have been extracted, harvested, or recovered within 500 miles of Project site.
  3. Regional Materials: Products shall be fabricated within 500 miles of Project site.
  4. Regional Materials: Products shall be fabricated within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.

## 2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, or Type 304 stainless steel fasteners for exterior use where built into exterior walls.
1. Select fasteners for type, grade, and class required.

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- B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.
- C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
  - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be shop primed with zinc-rich primer.
- E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency. Anchors to be specified by the licensed stair engineer.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Handrail Wall Brackets: Cast nickel-silver, center of rail 3-1/8 inches from face of wall.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Julius Blum & Co., Inc.
    - b. The Wagner Companies
- B. Welding Electrodes: Comply with AWS requirements.
- C. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- E. Zinc-Rich Primer: Comply with SSPC-Paint 20, Type II, Level 2, and compatible with topcoat.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- G. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

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H. Prefilled Concrete Treads:

1. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, steel, 4 by 4 inches, W1.4 by W1.4, unless otherwise indicated on Drawings.
  - a. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.
  - a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  1. Join components by welding unless otherwise indicated.
  2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs, railings, and guards in shop to greatest extent possible.
  1. Disassemble units only as necessary for shipping and handling limitations.
  2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
  1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
  2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Weld exposed corners and seams continuously unless otherwise indicated.
  5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

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1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Commercial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
  1. Stringers: Fabricate of steel channels as indicated on Drawings.
    - a. Stringer Size: As required to comply with "Performance Requirements" Article.
    - b. Provide closures for exposed ends of channel and rectangular tube stringers.
    - c. Finish: Painted.
  2. Platforms: Construct of steel plate or steel channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
    - a. Provide closures for exposed ends of channel and rectangular tube framing.
    - b. Finish: Painted.
  3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
  4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.
  1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
  2. Steel Sheet, Uncoated: Cold-rolled steel sheet.
  3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
  4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
  5. Shape metal pans to include nosing integral with riser.

2.7 FABRICATION OF STAIR RAILINGS AND GUARDS

- A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."

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- B. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
  - 1. Rails and Posts: 1-1/2-inch-diameter top and bottom rails and 1-1/2-inch-diameter posts.
  - 2. Picket Infill: 1/2-inch-round pickets spaced to prohibit the passage of a 4-inch diameter sphere.
  - 3. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with cam-type, self-closing hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.
- C. Welded Connections: Fabricate railings and guards with welded connections.
  - 1. Fabricate connections that are exposed to weather in a manner that excludes water.
    - a. Provide weep holes where water may accumulate internally.
  - 2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
  - 3. Weld all around at connections, including at fittings.
  - 4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 5. Obtain fusion without undercut or overlap.
  - 6. Remove flux immediately.
  - 7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint as shown in NAAMM AMP 521.
- D. Form changes in direction of railings and guards as follows:
  - 1. As detailed.
- E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing and guard members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
  - 1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- H. Connect posts to stair framing by direct welding unless otherwise indicated.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
  - 1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
  - 2. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

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3. Provide type of bracket with predrilled hole for exposed bolt anchorage, and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.
- J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.
  1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

## 2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
  2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
  1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
  1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.



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- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
  - 1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.
    - a. Clean bottom surface of plates.
    - b. Set plates for structural members on wedges, shims, or setting nuts.
    - c. Tighten anchor bolts after supported members have been positioned and plumbed.
    - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
    - e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
      - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
      - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
  - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
  - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
  - 3. Comply with requirements for welding in "Fabrication, General" Article.
- F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

### 3.3 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
  - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
  - 2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
  - 4. Secure posts, rail ends, and guard ends to building construction as follows:
    - a. Anchor posts to steel by welding to steel supporting members.
    - b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.

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- B. Install railing gates level, plumb, and secure for full opening without interference.
  - 1. Attach hardware using tamper-resistant or concealed means.
  - 2. Adjust hardware for smooth operation.
- C. Attach handrails to wall with wall brackets.
  - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
  - 2. Secure wall brackets to building construction as required to comply with performance requirements, and as follows:
    - a. For concrete and solid masonry anchorage, use drilled-in expansion anchors or epoxy-grouted threaded rods.
    - b. For hollow masonry anchorage, epoxy-grouted threaded rods within screen tubes.
    - c. For solid wood CLT connections, use lag bolts set perpendicular to grain. Do not fasten into end grain of CLT panels. Coordinate with carpentry work.
    - d. For steel-framed partitions, use lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

### 3.4 REPAIR

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
  - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

END OF SECTION

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SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel railings.

B. Related Requirements:

1. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes and guard-infill metals.

1.2 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Product Data:
1. Manufacturer's product lines of mechanically connected railings.
  2. Handrail brackets.
  3. Shop primer.
  4. Intermediate coats and topcoats.
  5. Paint products.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Samples for Verification: For each type of exposed finish required.
1. Sections of each distinctly different linear railing member, including handrails, top.
  2. Fittings and brackets.
- E. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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1.4 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

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- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

## 2.3 STEEL RAILINGS

- A. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
- B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A36/A36M.

## 2.4 FASTENERS

- A. Fastener Materials:
  - 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
  - 2. Finish exposed fasteners to match appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

## 2.5 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast stainless steel, center of handrail 3-1/8 inches from wall.
- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Intermediate Coats and Topcoats: Provide products that comply with Section 099123 "Interior Painting."

## 2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

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- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
  - 1. Clearly mark units for reassembly and coordinated installation.
  - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
  - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
  - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- F. Connections: Fabricate railings with welded connections unless otherwise indicated.
- G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.
- H. Form changes in direction as follows:
  - 1. By bending or by inserting prefabricated elbow fittings.
- I. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

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2.7 STEEL AND IRON FINISHES

- A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3.
- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting.
  - 1. Shop prime uncoated railings with universal shop primer unless indicated.
- D. Shop-Painted Finish: Comply with Section 099123 “Interior Painting.”
  - 1. Color: As selected by Architect from manufacturer's full range of standard and custom colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
  - 1. Fit exposed connections together to form tight, hairline joints.
  - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
  - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
  - 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- C. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

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3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

3.4 ATTACHING RAILINGS

- A. Attach handrails to walls with wall brackets. Provide brackets with 2-1/4 inch clearance from inside face of handrail and finished wall surface.
  - 1. Use type of bracket with predrilled hole for exposed bolt anchorage.
  - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

3.5 REPAIR

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

3.6 CLEANING

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION



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SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless steel decorative railings.

B. Related Requirements:

1. Section 055213 "Pipe and Tube Railings" for nonornamental railings fabricated from pipes and tubes.
2. Section 061000 "Rough Carpentry" for wood blocking for anchoring railings.

1.2 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data:
1. Manufacturer's product lines of decorative metal railings assembled from standard components.
  2. Stainless steel cable and cable fittings.
  3. Fasteners.
  4. Post-installed anchors.
  5. Handrail brackets.
  6. Wood rails.
  7. Nonshrink, nonmetallic grout.
  8. Anchoring cement.

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9. Metal finishes.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

D. Shop Drawings: Include plans, elevations, sections, and attachment details.

1. For illuminated railings, include wiring diagrams and roughing-in details.

E. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

F. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Qualification Data: For delegated design professional engineer.

C. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

D. Welding certificates.

E. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

F. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

G. Preconstruction test reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

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- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups for each form and finish of railing, consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches in length.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    - b. Infill load and other loads need not be assumed to act concurrently.

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2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.3 STAINLESS STEEL DECORATIVE RAILINGS

- A. Stainless Steel Decorative Railings:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide HDI Railing Systems, Circum Square, or comparable product by one of the following:
    - a. Atlantis Rail Systems
    - b. Greco; CSW Industrials Inc.
    - c. VIVA Railings, LLC
  - 2. Source Limitations: Obtain stainless steel decorative railing components from single source from single manufacturer.
- B. Tubing: ASTM A554, Grade MT 304.
- C. Pipe: ASTM A312/A312M, Grade TP 304.
- D. Castings: ASTM A743/A743M, Grade CF 8 or CF 20.
- E. Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304.
- F. Flat Bar: ASTM A666, Type 304.
- G. Bars and Shapes: ASTM A276/A276M, Type 304.
- H. Stainless steel infill rods, max. 9 ea. with guardrail height 42 inches. Infill rails to be 3/8-inch diameter solid stainless steel. Brushed finish #6 polished radially. Clamping knobs and fixtures to be stainless steel finished to match. Horizontal infill rails on approx. 4-inch centers, gaps between rods and adjacent posts to be equalized depending on required rail length and site conditions not to exceed 4 inches.

2.4 FASTENERS

- A. Fastener Materials:
  - 1. Stainless Steel Railing Components: Type 304 stainless steel fasteners.

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- B. Fasteners for Anchoring to Cross-Laminated Timber and Glue-Laminated Beams: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads imposed within a safety factor of 4, as determined by testing per ASTM E488.
  - 1. Acceptable anchors include but are not limited to lag screws and proprietary mechanical fasteners. Connections must be designed for withdrawal, lateral loading and combined withdrawal and lateral loading. Design connections in accordance with the National Design Specification for Wood Construction.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are the standard fastening method for railings indicated.
  - 1. Provide Phillips square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

## 2.5 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast stainless steel, center of handrail 2-1/2 inches from wall.
- B. Wood Rails:
  - 1. Clear, straight-grained hardwood rails secured to recessed metal subrail.
    - a. Species: Maple.
    - b. Finish: Manufacturer's standard.
    - c. Staining: As selected by Architect from manufacturer's full range.
    - d. Profile: Round, 1-1/2-inch diameter.
  - 2. Certified Wood: Wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

## 2.6 FABRICATION

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

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- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
  - 1. Clearly mark units for reassembly and coordinated installation.
  - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
  - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
  - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- F. Connections: Fabricate railings with mechanical connections unless otherwise indicated.
- G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings.
  - 1. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  - 2. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- H. Form changes in direction as follows:
  - 1. As detailed.
- I. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- J. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch or less.
- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide blocking or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- L. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.

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1. Provide socket covers designed and fabricated to resist being dislodged.
  2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- M. Stainless Steel Infill Rods: Fabricate rods from 3/8-inch diameter solid stainless steel.
1. Finish: Brushed finish #6 polished radially.
  2. Clamping knobs and fixtures: stainless steel finished to match.
  3. Horizontal infill rails: Approx. 4-inch centers, gaps between rods and adjacent posts to be equalized depending on required rail length and site conditions not to exceed 4 inches.

## 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.8 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  1. Run grain of directional finishes with long dimension of each piece.
  2. When polishing is completed, passivate and rinse surfaces.
  3. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Stainless Steel Tubing Finishes:
  1. Polished and Buffed Finish: 320-grit finish followed by buffing.
- D. Stainless Steel Sheet and Plate Finishes:
  1. Directional Satin Finish: ASTM A480/A480M, No. 4.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Installation shall be by a qualified, authorized representative of the manufacturer.
- B. Installation must be in accordance with standard or non-standard, yet applicable details (instructions) included on installation/shop drawings provided by the manufacturer.
- C. Perform cutting, drilling, and fitting required for installing railings.
  - 1. Fit exposed connections together to form tight, hairline joints.
  - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
  - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
  - 4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 50 feet.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- E. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- F. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.



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- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

### 3.4 ANCHORING POSTS

- A. Anchor posts to cross laminated timber and glue-laminated beam with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For stainless steel railings, weld flanges to posts and fasten to cross laminated timber/glulam-supporting surfaces.

### 3.5 ATTACHING RAILINGS

- A. Anchor railing ends to cross laminated timber/glulam surfaces with flanges bolted to cross laminated timber/glulam surfaces and connected to railing ends, using mechanical fastener connections.
- B. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
  - 1. Use type of bracket with flange tapped for concealed anchorage as indicated in delegated design.
  - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For cross laminated timber/glulam construction use lag screws or proprietary mechanical fasteners.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.
- B. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.
- C. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

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3.7 CLEANING

- A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.
- B. Clean wood rails by wiping with a damp cloth and then wiping dry.

3.8 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

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SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood-preserved-treated lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking and nailers.
4. Wood furring.
5. Wood sleepers.
6. Utility shelving.
7. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, and underlayment.
2. Structural drawings for dimensional lumber, engineered lumber, and subflooring requirements.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  1. Include data for wood-preserved treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

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2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Material Certificates:
  1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.
  2. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP A U1, Use categories as follows:
  1. UC2: Interior construction not in contact with ground but may be subject to moisture. Include the following items:

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- a. Wood sills, sleepers, blocking, furring and similar concealed members in contact with masonry or concrete.
    - b. Wood floor plates that are installed over concrete slabs-on-grade.
    - c. Wood millwork.
  2. UC3A (All Other Commodity Specifications): Coated products excluding sawn products in exterior construction not in contact with ground, exposed to all weather cycles but protected from liquid water. Include the following items:
    - a. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
    - b. Wood floor plates that are installed over concrete slabs-on-grade.
  3. UC4A (Commodity Specification A): Non-critical sawn products in contact with ground and exposed to all weather cycles including continuous or prolonged wetting, and sawn products not in contact with ground but with ground contact-type hazards or that are critical or hard to replace. Include the following items:
    - a. Wood framing members that are less than 6 inches (152 mm) above the ground.
    - b. Joists and beams when they are difficult to maintain, repair, or replace and are critical to the performance and safety of the entire system/construction.
  4. After treatment, redry dimension lumber to 19 percent maximum moisture content.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
1. Wood nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
  3. Wood floor plates that are installed over concrete slabs-on-grade.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

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1. Treatment shall not promote corrosion of metal fasteners.
  2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
  3. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
1. Plywood backing panels.

## 2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
  2. Nailers.
  3. Rooftop equipment bases and support curbs.
  4. Furring.
  5. Utility shelving.
- B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of any of the following species:
1. Hem-fir (north); NLGA.
  2. Spruce-pine-fir; NLGA.
  3. Northern species; NLGA.
  4. Eastern softwoods; NeLMA.
- C. Utility Shelving: Lumber with 15 percent maximum moisture content of any of the following species and grades:
1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Standard or No. 3 Common grade; NeLMA or NLGA.
  2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA.
- D. Concealed Boards: 19 percent maximum moisture content of any of the following species and grades:
1. Hem-fir or hem-fir (north), Standard or No. 3 Common grade; NLGA.
  2. Eastern softwoods, No. 3 Common grade; NELMA.
  3. Northern species, No. 3 Common grade; NLGA.

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- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

2.7 METAL FRAMING ANCHORS

- A. Materials: Unless otherwise indicated, fabricate from the following materials:
  - 1. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
    - a. Use for interior locations unless otherwise indicated.
  - 2. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
    - a. Use for wood-preservative-treated lumber and where indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- B. Sill-Sealer Gaskets:

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1. Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.
2. Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
- I. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- J. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.



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1. Use inorganic boron for items that are continuously protected from liquid water.
  2. Use copper naphthenate for items not continuously protected from liquid water.
- K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
  2. ICC-ES evaluation report for fastener.
- L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

### 3.2 WOOD BLOCKING AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

### 3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Gypsum Board: Install 1-by-3-inch nominal- size furring vertically at 16 inches o.c.

### 3.4 PROTECTION

- A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

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SECTION 061300 - HEAVY TIMBER CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Timber.
2. Round wood poles.
3. Timber connectors.
4. Miscellaneous materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for dimension lumber items associated with heavy timber framing.
2. Section 061516 "Wood Roof Decking."
3. Section 061719 "Cross-Laminated Timber."
4. Section 061800 "Glued-Laminated Construction."

1.2 DEFINITIONS

- A. Timbers: Lumber of 5 inches nominal or greater in least dimension.
- B. Poles: Round wood members, called either "poles" or "posts" in the referenced standards.
- C. Inspection agencies, and the abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
  2. NHLA: National Hardwood Lumber Association.
  3. NLGA: National Lumber Grades Authority.
  4. SPIB: Southern Pine Inspection Bureau (The).
  5. WCLIB: West Coast Lumber Inspection Bureau.
  6. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Product Data: For timber connectors.
1. For timber connectors. Include installation instructions.
- C. Shop Drawings: For heavy timber framing. Show layout, dimensions of each member, and details of connections.

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- D. Samples: Not less than 7 inches wide by 24 inches long, showing the range of variation to be expected in appearance, including surface texture, of wood products. Apply a coat of penetrating sealer to Samples.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Material Certificates:
  - 1. For timbers specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by ALSC's Board of Review.
- C. Certificates of Inspection: Issued by lumber-grading agency for exposed timber not marked with grade stamp.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Schedule delivery of materials to avoid extended on-site storage and to avoid delaying the Work.
- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 TIMBER

- A. Comply with DOC PS 20 and with grading rules of lumber-grading agencies certified by ALSC's Board of Review as applicable.
  - 1. Factory mark each item of timber with grade stamp of grading agency.
  - 2. For exposed timber indicated to receive a stained or natural finish, apply grade stamps to surfaces that are not exposed to view, or omit grade stamps and provide certificates of grade compliance issued by grading agency.
- B. Timber Species and Grade:
  - 1. Balsam fir, Douglas fir-larch, Douglas fir-larch (North), eastern hemlock tamarack (North), hem-fir, southern pine, western hemlock, or western hemlock (North); No. 2, NeLMA, NLGA, SPIB, WCLIB, or WWPA.
- C. Moisture Content: Provide timber with 19 percent maximum moisture content at time of dressing.
- D. Dressing: Provide dressed timber (S4S) unless otherwise indicated.

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2.2 ROUND WOOD POLES

- A. Round Wood Poles: Clean-peeled wood poles complying with ASTM D3200; with at least 80 percent of inner bark removed and with knots and limbs cut flush with the surface.
- B. Species:
  - 1. Structural Round Timber Beams and Trusses: Red Spruce, Eastern White Pine, Aspen/Poplar, Eastern Hemlock; No. 2.
  - 2. Structural Round Timber Columns: Sugar Maple, Hemlock, Spruce, Aspen, Yellow Birch, White Oak, Hemlock, Black Locust; No. 2.

2.3 TIMBER CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Simpson Strong-Tie Co., Inc.
- B. Fabricate connectors using steel plate sizes and dimensions as indicated in Drawings.
- C. Provide bolts, of size indicated, complying with ASTM A307, Grade A; provide nuts complying with ASTM A563; and, where indicated, provide flat washers.
- D. Provide stainless steel bolts, of size indicated, complying with ASTM F593, Alloy Group 1 or 2; provide nuts complying with ASTM F594, Alloy Group 1 or 2; and, where indicated, provide flat washers.
- E. Materials: Unless otherwise indicated, fabricate from the following materials:
  - 1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
  - 2. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.
  - 3. Stainless steel plate, sheet, and strip complying with ASTM 240/A240M or ASTM A666, Type 304.
  - 4. Stainless steel flat bars complying with ASTM A666, Type 304.
  - 5. Stainless steel bars and shapes complying with ASTM A276, Type 304.
- F. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.
- G. Hot-dip galvanize steel assemblies and fasteners where indicated after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

2.4 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

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2.5 FABRICATION

- A. Shop fabricate members by cutting and restoring exposed surfaces to match specified surfacing. Finish exposed surfaces to remove planing or surfacing marks, and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
- B. Predrill for fasteners and assembly of units.
- C. Coat crosscuts with end sealer.
- D. Seal Coat: After fabricating and surfacing each unit, apply a saturation coat of penetrating sealer on surfaces of each unit except for treated wood where the treatment included a water repellent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Erect heavy timber framing true and plumb. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
  - 1. Install horizontal and sloping members with crown edge up, and provide not less than 4 inches of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports with metal strap ties if not continuous.
  - 2. Handle and temporarily support heavy timber framing to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- C. Fitting: Fit members by cutting and restoring exposed surfaces to match specified surfacing.
  - 1. Predrill for fasteners using timber connectors as templates.
  - 2. Finish exposed surfaces to remove planing or surfacing marks, and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
  - 3. Coat crosscuts with end sealer.
  - 4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.
- D. Install timber connectors as indicated.
  - 1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
  - 2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.2 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged heavy timber framing if repairs are not approved by Architect.

END OF SECTION

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SECTION 061516 - WOOD ROOF DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-sawn wood roof decking.
2. Glue-laminated wood roof decking.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for dimension lumber items associated with wood roof decking.
2. Section 061300 "Heavy Timber Construction."
3. Section 061719 "Cross-Laminated Timber."
4. Section 061800 "Glued-Laminated Construction."

1.2 ACTION SUBMITTALS

A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Product Data: For each type of product.

1. For glued-laminated wood roof decking, include installation instructions and data on lumber, adhesives, and fabrication.

C. Samples: 24 inches long, showing the range of variation to be expected in appearance of wood roof decking.

1.3 INFORMATIONAL SUBMITTALS

A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Research/Evaluation Reports: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Schedule delivery of wood roof decking to avoid extended on-site storage and to avoid delaying the Work.

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- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Stack wood roof decking with surfaces that are to be exposed in the final Work protected from exposure to sunlight.

PART 2 - PRODUCTS

2.1 WOOD ROOF DECKING, GENERAL

- A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

2.2 SOLID-SAWN WOOD ROOF DECKING

- A. Standard for Solid-Sawn Wood Roof Decking: Comply with AITC 112.
- B. Roof Decking Species:
  - 1. Balsam fir, Douglas fir-larch, Douglas fir-larch (North), hem-fir, hem-fir (North), southern pine, spruce pine-fir (North).
- C. Roof Decking Nominal Size: 2 by 6.
- D. Roof Decking Grade:
  - 1. Select Decking.
- E. Grade Stamps: Factory mark each item with grade stamp of grading agency. Apply grade stamp to surfaces that are not exposed to view.
- F. Moisture Content: Provide wood roof decking with 15 percent maximum moisture content at time of dressing.
- G. Face Surface: Rough sanded or wire brushed.
- H. Edge Pattern: Vee grooved.

2.3 GLUED-LAMINATED WOOD ROOF DECKING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Structural Wood Systems; A Division of Harrison Industries.
- B. Face Species: Douglas fir-larch or Douglas fir-larch (North) or Southern pine.
- C. Roof Decking Nominal Size: 2 by 6.

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- D. Roof Decking Configuration: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, provide tongue-and-groove configuration that complies with research/evaluation report.
- E. Face Grade:
  - 1. Decorative: Sound knots and natural characteristics are allowed, including chipped edge knots, short end splits, seasoning checks, and some pin holes. Face knot holes, stains, end slits, skips, roller splits, and planer burns are not allowed.
- F. Moisture Content: Provide wood roof decking with 15 percent maximum moisture content at time of dressing.
- G. Face Surface: Rough sanded or wire brushed.
- H. Edge Pattern: Vee grooved.
- I. Laminating Adhesive: Wet-use type complying with ASTM D2559.

## 2.4 ACCESSORY MATERIALS

- A. Fasteners for Solid-Sawn Roof Decking: Provide fastener size and type complying with AITC 112 for thickness of deck used.
- B. Fasteners for Glued-Laminated Roof Decking: Provide fastener size and type complying with requirements in "Installation" Article for installing laminated roof decking.
- C. Nails: Common; complying with ASTM F1667, Type I, Style 10.
- D. Spikes: Round; complying with ASTM F1667, Type III, Style 3.
- E. Sealants: Latex, complying with applicable requirements in Section 079200 "Joint Sealants" and recommended by sealant manufacturer and manufacturer of substrates for intended application.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Structural Wood Systems; A Division of Harrison Industries.
- F. Penetrating Sealer: Clear sanding sealer complying with Section 099300 "Staining and Transparent Finishing" and compatible with topcoats specified for use over it.

## 2.5 FABRICATION

- A. Seal Coat: After fabricating and surfacing roof decking, apply a saturation coat of penetrating sealer in fabrication shop.
- B. Apply indicated finish materials to comply with Section 099300 "Staining and Transparent Finishing" in fabrication shop.



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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and support framing in areas to receive wood roof decking for compliance with installation tolerances and other conditions affecting performance of wood roof decking.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install solid-sawn wood roof decking to comply with AITC 112.
  - 1. Locate end joints for two-span continuous lay-up.
- B. Install laminated wood roof decking to comply with manufacturer's written instructions.
  - 1. Locate end joints for two-span continuous lay-up.
  - 2. Nail each course of glued-laminated wood roof decking at each support with one nail slant nailed above the tongue and two nails straight nailed through the face.
    - a. Use 20d nails for 2-by-6 and 2-by-8 roof decking.
  - 3. Slant nail each course of glued-laminated wood roof decking to the tongue of the adjacent course at 24 inches o.c. and within 12 inches of the end of each unit. Stagger nailing 15 inches in adjacent courses.
    - a. Use 8d nails for 2-by-6 and 2-by-8 roof decking.
- C. Anchor wood roof decking, where supported on walls, with screws as indicated.
- D. Apply joint sealant to seal roof decking at exterior walls at the following locations:
  - 1. Between roof decking and supports located at exterior walls.

3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged roof decking if repairs are not approved by Architect.

3.4 PROTECTION

- A. Provide water-resistive barrier over roof decking as the Work progresses to protect roof decking until roofing is applied.

END OF SECTION

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SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.2 ACTION SUBMITTALS

A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Product Data:

1. Wall sheathing.
2. Roof sheathing.

C. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

D. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.

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2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Qualification Data: For Installer, including list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
- C. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.
- D. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.
- E. Evaluation Reports: For the following, from ICC-ES:
  1. Wood-preserved-treated plywood.
  2. Fire-retardant-treated plywood.
  3. Foam-plastic sheathing.
  4. Air-barrier and water-resistant glass-mat gypsum sheathing.
- F. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.
  1. Installer is to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and is to employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution.
  1. Build integrated mockups of exterior wall assembly as indicated on Drawings, incorporating backup wall construction, window, storefront, door frame and sill, ties and other penetrations, and flashing to demonstrate crack and joint treatment and sealing of gaps, terminations, and penetrations of air-barrier sheathing assembly.
    - a. Coordinate construction of mockups to permit inspection and testing of sheathing before external insulation and cladding are installed.
    - b. Include junction with roofing membrane and foundation wall intersection.
    - c. If Architect determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.

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2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Testing Agency Qualifications:

1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
2. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified in accordance with ASTM E329 for testing indicated, and certified by Air Barrier Association of America, Inc.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups.
- B. Mockup Testing: Air-barrier and water-resistant glass-mat gypsum sheathing assemblies are to comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, are to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies are to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to other

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installed air barriers, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 WOOD PANEL PRODUCTS

- A. Emissions: Products are to meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC3b for exterior construction not in contact with ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  - 1. Use treatment that does not promote corrosion of metal fasteners.
  - 2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
  - 3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.

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4. Design Value Adjustment Factors: Treated lumber plywood is to be tested in accordance with ASTM D5516 and design value adjustment factors are to be calculated in accordance with ASTM D6305. Span ratings after treatment are to be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F are to be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings.

## 2.5 WALL SHEATHING

- A. Plywood Sheathing, Walls: , Exposure 1, Structural I sheathing.
  1. Span Rating: Not less than 32/16.
  2. Nominal Thickness: Not less than 1/2 inch.
- B. Oriented-Strand-Board Sheathing, Walls: DOC PS 2, Exposure 1, Structural I sheathing.
  1. Span Rating: Not less than 32/16.
  2. Nominal Thickness: Not less than 1/2 inch.
- C. Paper-Surfaced Gypsum Sheathing: ASTM C1396/C1396M, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. American Gypsum.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Georgia-Pacific Gypsum LLC.
    - d. USG Corporation.
  2. Type and Thickness: Type X, 5/8 inch thick.
  3. Edge and End Configuration: Square.
  4. Size: 48 by 96 inches for vertical installation.
- D. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. CertainTeed; SAINT-GOBAIN.
    - b. Continental Building Products Inc.

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- c. Georgia-Pacific Gypsum LLC.
    - d. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - e. [USG Corporation](#).
  2. Type and Thickness: Type X, 5/8 inch thick.
  3. Size: 48 by 96 inches for vertical installation.
- E. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M, Type X, coated fiberglass mat gypsum sheathing with integral weather-resistant barrier and air barrier complying with ASTM E2178.
1. [Manufacturers](#): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Georgia-Pacific Gypsum LLC.
    - b. [USG Corporation](#).
  2. Thickness: 5/8 inch thick.
  3. Size: 48 by 96 inches for vertical installation.
  4. Edges: Square.
  5. Flashing and Transitions Strips: As acceptable to sheathing manufacturer.
  6. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference when tested in accordance with ASTM E2178.
  7. Vapor Permeance: Minimum 20 perms when tested in accordance with ASTM E96/E96M, Desiccant Method, Procedure A.
  8. Sheathing Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. when tested in accordance with ASTM E2357.
  9. Fire Propagation Characteristics: Complies with NFPA 285 testing as part of an approved assembly.
  10. UV Resistance: Can be exposed to sunlight for [30] [90] [180] <Insert number> days in accordance with manufacturer's written instructions.
  11. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by sheathing manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- F. Cementitious Backer Units, Walls: ASTM C1325, Type A.
1. [Manufacturers](#): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. [C-Cure](#).
    - b. [Custom Building Products](#).
    - c. [FinPan, Inc.](#)
    - d. USG Corporation.
  2. Thickness: As indicated.

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2.6 ROOF SHEATHING

- A. Plywood Sheathing, Roofs: , Exposure 1, Structural I sheathing.
  - 1. Span Rating: Not less than 40/20.
  - 2. Nominal Thickness: Not less than 5/8 inch.
- B. Oriented-Strand-Board Sheathing, Roofs: DOC PS 2, Exposure 1, Structural I sheathing.
  - 1. Span Rating: Not less than 40/20.
  - 2. Nominal Thickness: Not less than 5/8 inch.

2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
  - 2. For wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
  - 1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
  - 2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.



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- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
  - 2. ICC-ES evaluation report for fastener.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 INSTALLATION OF WOOD STRUCTURAL PANEL

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated.

### 3.3 INSTALLATION OF GYPSUM SHEATHING

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to wood framing with screws.
  - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  - 4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

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2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
  2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints in accordance with sheathing manufacturer's written instructions.
1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
  2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.
- F. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing:
1. Install accessory materials in accordance with sheathing manufacturer's written instructions and details to form a seal with adjacent construction, to seal fasteners, and ensure continuity of air and water barrier.
    - a. Coordinate the installation of sheathing with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
    - b. Install transition strip on roofing membrane or base flashing, so that a minimum of 3 inches of coverage is achieved over each substrate.
  2. Connect and seal sheathing material continuously to air barriers specified under other Sections as well as to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
  3. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
  4. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip, so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
    - a. Transition Strip: Roll firmly to enhance adhesion.
  5. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of sheathing material with foam sealant.
  6. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

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7. Seal top of through-wall flashings to sheathing with an additional 6-inch-wide, transition strip.
8. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
9. Repair punctures, voids, and deficient lapped seams in strips and transition strips extending 6 inches beyond repaired areas in strip direction.

3.4 INSTALLATION OF CEMENTITIOUS BACKER UNITS

- A. Install panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Testing and Inspecting Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Inspections: Air-barrier and water-resistant glass-mat gypsum sheathing, accessories, and installation are subject to inspection for compliance with requirements.
- D. Tests: As determined by testing agency from among the following tests:
  1. Air-Leakage-Location Testing: Air-barrier sheathing assemblies will be tested for evidence of air leakage in accordance with ASTM E1186, chamber pressurization or depressurization with smoke tracers.
  2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with ASTM E783.
- E. Air barriers will be considered defective if they do not pass tests and inspections.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- G. Prepare test and inspection reports.

END OF SECTION

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SECTION 061719 - CROSS-LAMINATED TIMBER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural cross-laminated timber.
2. Timber connectors.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.
2. Section 061300 "Heavy Timber Construction" for framing using timbers and round wood poles.
3. Section 061516 "Wood Roof Decking" for glued-laminated wood roof decking.
4. Section 061800 "Glued-Laminated Construction" for structural glued-laminated timber.

1.2 DEFINITIONS

- A. Cross-Laminated Timber: A prefabricated engineered wood product made of at least three orthogonal layers of graded sawn lumber that are laminated by gluing with structural adhesives.

1.3 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Product Data: For each type of product.

1. Include data on lumber, adhesives, fabrication, and protection.
2. For connectors. Include installation instructions.

C. Shop Drawings:

1. Show layout, sequence of placement, location, sizes, overall dimensions, and screw and attachment locations of cross-laminated timber system and full dimensions of each panel.
2. Indicate species and layup combination.
3. Include any reinforcement necessary for safe handling and erection of panels. Identify each panel and the corresponding sequence followed during installation.
4. Include large-scale details of connections.
5. Verify all field measurements prior to preparation of shop drawings to ensure proper fitting of the work.

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- D. Samples: Full depth, 12 inches long x 12 inches wide, showing the range of variation to be expected in appearance of structural cross-laminated timber. Submit one sample for each panel type: wall, floor, and roof.

- 1. Apply specified factory finish to three sides of half length of each Sample.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural cross-laminated timber complies with requirements in ANSI/APA PRG 320. Include the following information in the certification.
  - 1. CLT Manufacturer's standards
  - 2. CLT stress grade and appearance classification
  - 3. Layup of wood, species and grades used
  - 4. Manufacturer's panel durability tests and testing results for the same material, grades, and layups to be used on the Project

#### 1.5 QUALITY ASSURANCE

- A. Provide panels that meet ANSI/APA PRG 320 standards.
- B. Manufacturer Qualifications: Panels must be factory produced by an American Institute of Timber Construction (AITC) or APA licensed manufacturer. Factory mark every panel with AITC Quality Mark or APA-EWS trademark, mill, layup, and provide a certificate of conformance. Marks must not be visible in final assembly.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Individually wrap members using plastic-coated paper covering with water-resistant seams, suitable to protect panels for prolonged inclement weather conditions after erected. Label panels and deliver to the project site in sequence of construction for the project.
- B. Submit manufacturer's procedures for handling, erection, and sequencing.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Structural cross-laminated timber and connectors are to withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in ANSI/APA PRG 320 and acceptable to authorities having jurisdiction.

## 2.2 STRUCTURAL CROSS-LAMINATED TIMBER

- A. General: Provide structural cross-laminated timber fabricated in accordance with ANSI/APA PRG 320.
  - 1. Factory mark each panel with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
  - 2. Provide structural cross-laminated timber made from single species.
  - 3. Provide structural cross-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
- B. Species and Grade for Structural Cross-Laminated Timber:
  - 1. CLT panels must be E3 stress grade, graded in accordance with ANSI/APA PRG 320.
  - 2. Any species that complies with stress grade indicated.
  - 3. Lay-up: Balanced.
- C. Appearance Classification: Architectural, in accordance with ANSI/APA PRG 320.
- D. Moisture Content: Comply with ANSI/APA PRG 320 for moisture content. At the time of manufacturing, moisture content must be 12%, +/- 3%, and compatible with the criteria of the certified adhesive.
- E. Adhesive: Adhesives must be certified by test for use with the species to which they are applied in accordance with ANSI/APA PRG 320. Apply and allow set times as required by the adhesive manufacturer's instructions. Apply pressure on the panels for the duration of manufacturing as required by the adhesive manufacturer's instructions.

## 2.3 TIMBER CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. MTC Solutions.
  - 2. Simpson Strong-Tie Co., Inc.
- B. Fabricate connectors using steel plate sizes and dimensions as indicated in Drawings.
- C. Provide bolts, of size indicated, complying with ASTM A307, Grade A; nuts complying with ASTM A563; and, where indicated, flat washers.
- D. Materials: Unless otherwise indicated, fabricate from the following materials:
  - 1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
  - 2. Steel headed stud anchors complying with ASTM A108.
  - 3. Hot-rolled steel sheet complying with ASTM A653, Grade 33.
  - 4. Stainless steel flat bars complying with ASTM A666, Type 304.
  - 5. Stainless steel bars and shapes complying with ASTM A276, Type 304.
  - 6. Stainless steel plate, sheet, and strip complying with ASTM A240/A240M or ASTM A666, Type 304.
- E. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.

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- F. All metal surfaces must be clean of oil, dirt, rust, and foreign matter.

## 2.4 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

## 2.5 FABRICATION

- A. CLT panels must be fabricated in strict conformance to approved shop drawings. s
- B. Shop fabricate CLT panels for connections, including cutting to length and width, machining for connections and fitment, and drilling bolt holes.
  - 1. Dress exposed surfaces as needed to remove planing and surfacing marks.
- C. CLT panels must be fabricated to join tightly and in proper alignment, in accordance with ANSI/APA PRG 320.

## 2.6 FACTORY FINISHING

- A. Clear Finish: Manufacturer's standard, resistant to mildew and fungus.
  - 1. Water repellent.
  - 2. Film-forming two-coat, varnish.
- B. Semitransparent Stain Finish: Manufacturer's standard oil-based stain, resistant to mold and fungus.
  - 1. Color: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates in areas to receive structural cross-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work. Verify supporting surfaces are level and constructed to correct elevations and dimensions.
- B. Clean supports and connection hardware of any dirt, oil, rust, or foreign matter.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

- A. General: Erect structural cross-laminated timber true and plumb and with uniform, close-fitting, neat joints without binding or adding stresses to panels. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place. The Contractor is responsible for all temporary shoring and bracing which may be required for erection sequence, installation procedures, and coordination with other trades.
  - 1. Handle and temporarily support cross-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication and only proceed with approval from the engineer of record. Coat all cuts with end sealer.
- C. Install timber connectors as indicated.
  - 1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
  - 2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural cross-laminated timber if repairs are not approved by Architect.

3.4 PROTECTION

- A. Cover each panel with temporary waterproof protection to maintain the low moisture content of the wood. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
  - 1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
  - 2. Protect panels against excessive and repeated water deposits and standing water at all times. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.
  - 3. Take precautions to closely maintain the manufacturer's standard for moisture content. Elevate initial building heating/cooling gradually to the desired level. Do not reduce the relative humidity of the building rapidly.

END OF SECTION



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SECTION 061800 - GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural glued-laminated timber.
2. Timber connectors.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.
2. Section 061300 "Heavy Timber Construction" for framing using timbers and round wood poles.
3. Section 061516 "Wood Roof Decking" for glued-laminated wood roof decking.
4. Section 061719 "Cross-Laminated Timber" for orthogonally glued-laminated wood floor, roof, and wall panels.

1.2 DEFINITIONS

- A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.3 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Product Data: For each type of product.

1. Include data on lumber, adhesives, fabrication, and protection.
2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
3. For connectors. Include installation instructions.

C. Shop Drawings:

1. Show layout of structural glued-laminated timber system and full dimensions of each member.
2. Indicate species and laminating combination.
3. Include large-scale details of connections.

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D. Delegated Design Calculations:

1. Submit design calculations for braced framed connections. Calculations must be signed and sealed by Licensed Professional Engineer in State of Maine.

E. Brace Frame Connections:

1. Submit shop drawings indicating connection types, dimensions and fastener requirement. Drawing must be signed and sealed by a Licenses Professional Engineer in the State of Maine.

F. Samples: Full width and depth, 24 inches long, showing the range of variation to be expected in appearance of structural glued-laminated timber including variations due to specified treatment.

1. Apply specified factory finish to three sides of half length of each Sample.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in ANSI A190.1.
- C. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.
- D. Research/Evaluation Reports: For structural glued-laminated timber and timber connectors, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Structural glued-laminated timber and connectors are to withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in ANSI 117 or determined according to ASTM D3737 and acceptable to authorities having jurisdiction.

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B. Braced Frame Connections:

1. Design braced frame connections for the forces indicated. Details in contract drawings are intended to show the design intent of the connections. Calculations must be performed in accordance with the National Design Specification for Wood Construction. Design may be done using either Allowable Stress Design (ASD) or Load Resistance Factor Design (LRFD).

C. Seismic Performance: Structural glued-laminated timber and connectors are to withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

A. General: Provide structural glued-laminated timber that complies with ANSI A190.1 and ANSI 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
2. Provide structural glued-laminated timber made from single species.
3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
4. Provide structural glued-laminated timber made with wet-use adhesive complying with ANSI A190.1.

B. Species and Grades for Structural Glued-Laminated Timber:

1. Southern pine that complies with beam stress classifications indicated.

C. Species and Grades: For beams and purlins.

1. Species and Beam Stress Classification: Southern pine, 24F-1.8E.
2. Lay-up: Balanced.

D. Species and Grades for Columns:

1. Species and Combination Symbol: Southern pine, 49.

E. Appearance Grade: Premium, complying with AITC 110.

1. For Premium and Architectural appearance grades, fill voids as required by AITC 110. For Premium appearance grade, use clear wood inserts, of matching grain and color, for filling voids and knot holes more than 1/4 inch wide.

2.3 PRESERVATIVE TREATMENT

A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWPA U1, Use Category 4A.

1. Use preservative solution without substances that might interfere with application of indicated finishes.

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2. Do not incise structural glued-laminated timber or wood used to produce structural glued-laminated timber.

B. Preservative:

1. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.

2.4 TIMBER CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Simpson Strong-Tie Co., Inc.
2. MTC Solutions.

B. Fabricate column bases and beam seats from steel with thicknesses, dimensions, and fasteners as indicated in Drawings.

C. Fabricate beam hangers from steel with dimensions, or specific product, and fasteners as indicated in Drawings.

D. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A668/A668M.

E. Provide bolts, of size indicated, complying with ASTM A307, Grade A; nuts complying with ASTM A563; and, where indicated, flat washers.

F. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.

G. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.

H. Hot-dip galvanize steel assemblies and fasteners where indicated after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

2.5 MISCELLANEOUS MATERIALS

A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.6 FABRICATION

A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.

1. Dress exposed surfaces as needed to remove planing and surfacing marks.

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- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. End-Cut Sealing: Immediately after end cutting each member to final length and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.
- D. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

## 2.7 FACTORY FINISHING

- A. Clear Finish: Manufacturer's standard, resistant to mildew and fungus.
  - 1. Water repellent.
  - 2. Film-forming two-coat, varnish.
- B. Semitransparent Stain Finish: Manufacturer's standard oil-based stain, resistant to mold and fungus.
  - 1. Color: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
  - 1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Framing Built into Masonry: Provide 1/2-inch clearance at tops, sides, and ends of members built into masonry; bevel cut ends 3 inches; and do not embed more than 4 inches unless otherwise indicated.
- C. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

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- D. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.
  - 1. Predrill for fasteners using timber connectors as templates.
  - 2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
  - 3. Coat cross cuts with end sealer.
  - 4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.
    - a. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- E. Install timber connectors as indicated.
  - 1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
  - 2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

### 3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

### 3.4 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
  - 1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
  - 2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION

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SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standing and running trim for transparent finish.
2. Pre-manufactured modular wood paneling.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.

1.2 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.

- C. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

D. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration (EPD): For each product.

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3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- E. Shop Drawings:
  1. Include the following:
    - a. Dimensioned plans, elevations, and sections.
    - b. Attachment details.
  2. Show large-scale details.
- F. Samples: For each exposed product and for each shop-applied color and finish specified.
  1. Size:
    - a. Lumber Products: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
- G. Samples for Initial Selection: For each type of shop-applied exposed finish.
  1. Size:
    - a. Lumber Products: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For architectural woodwork manufacturer and Installer.
- C. Evaluation Reports: For fire-retardant-treated wood materials; from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
  1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
  2. Installer Qualifications: Licensed participant in AWI's Quality Certification Program.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  1. Build mockups of typical interior architectural woodwork as shown on Drawings.



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2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Architectural Woodwork Standards, Section 2.
- B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.
- C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
  1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.8 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.
- B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
  1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
  1. Provide certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.
- B. Certified Wood: Wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.

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2.2 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Architectural Woodwork Standards Grade: Custom.
- B. Hardwood Lumber:
  - 1. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
  - 2. Species: Douglas Fir.
  - 3. Cut: Plain sliced/plain sawn.
  - 4. Wood Moisture Content: 5 to 10 percent.

2.3 PRE-MANUFACTURED MODULAR WOOD PANELING-FIRE RETARDANT

- A. Basis-of-Design: Provide 3D Stick Modular Panels by Terramai.
- B. Wood Species: White Oak.
- C. Backer: 1/2-inch thick, FSC® Certified, 5-ply plywood with Class A fire retardant applied.
- D. Panel Rating: Class A flame-spread index of 25 or less when tested in accordance with ASTM E84.
- E. Size: Modular 8 feet by 1 foot 10 inches.

2.4 MISCELLANEOUS MATERIALS

- A. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
  - 1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
  - 2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.
  - 1. Adhesives shall have a VOC content of 70 g/L or less.

2.5 FABRICATION

- A. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.
  - 1. Ease edges to radius indicated for the following:
    - a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
    - b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch.

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- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.
  - 1. Disassemble components only as necessary for shipment and installation.
  - 2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
  - 3. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.
    - a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
    - b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

## 2.6 SHOP PRIMING

- A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
- B. Interior Architectural Woodwork for Transparent Finish: Shop-seal concealed surfaces with required pretreatments and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."
  - 1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

## 2.7 SHOP FINISHING

- A. Finish interior architectural woodwork with stain and transparent finish indicated on Drawings at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.
- C. Finish Systems Schedule: Refer to Section 099300, "Staining and Transparent Finishing."

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

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- B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

### 3.2 INSTALLATION

- A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.
- B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.
- C. Install interior architectural woodwork level, plumb, true in line, and without distortion.
  - 1. Shim as required with concealed shims.
  - 2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.
  - 1. Secure with countersunk, concealed fasteners and blind nailing.
  - 2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
  - 3. For shop-finished items, use filler matching finish of items being installed.
- G. Standing and Running Trim:
  - 1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
  - 2. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary.
  - 3. Scarf running joints and stagger in adjacent and related members.
  - 4. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished.
  - 5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

### 3.3 REPAIR

- A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

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- B. Where not possible to repair, replace defective woodwork.
- C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.
  - 1. Fill nail holes with matching filler where exposed.
  - 2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.
- D. Field Finish: See Section 099123 "Interior Painting" for final finishing of installed interior architectural woodwork not indicated to be shop finished.

3.4 CLEANING

- A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Plastic-laminate-clad architectural cabinets.
- 2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
- 2. Section 123661 "Simulated Stone Countertops."

1.3 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product.

- 1. Include panel material description and finish.
- 2. Include accessories.
- 3. Include hardware.

C. Shop Drawings:

- 1. Include plans, elevations, sections, and attachment details.
- 2. Show large-scale details.

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3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

D. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating percentage of postconsumer and preconsumer recycled content and cost.
2. Product Data: Verify compliance with requirements for Forest Stewardship Council U.S. (FSC).
3. Laboratory Test Reports: For composite wood products, indicating compliance with the formaldehyde emissions evaluation.
4. Product Data: For installation adhesives, indicating VOC content.
5. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For manufacturer and Installer.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

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1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
  1. Structural Performance Duty Level: 2.
  2. Aesthetic Performance Grade: Custom.
  3. Product Data: Verify materials were fabricated within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.
  4. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in CARB 93120, "Airborne Toxic Control Measure (ATCM) for Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
  5. Verify adhesives have a VOC content of 30 g/L or less.
- B. Type of Construction: Frameless.
- C. Door and Drawer-Front Style: Flush overlay.
- D. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality standard.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Abet Laminati Inc.
    - b. Formica Corporation.
    - c. Lamin-Art, Inc.
    - d. Pionite; a Panolam Industries International, Inc. brand.
    - e. Wilsonart.
- E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  1. As indicated by laminate manufacturer's designations.
  2. Match Architect's sample.
  3. As selected by Architect from laminate manufacturer's full range in the following categories:
    - a. Solid colors: Basis of Design: Wilsonart Traceless (velvet finish).
    - b. Wood grains: Basis of Design: Wilsonart Soft Grain finish.
    - c. Patterns: matte finish.



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F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade HGS.
3. Edges: PVC edge banding, 0.18 inch thick, matching laminate in color, pattern, and finish.
4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
  - a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
  - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2.
3. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
4. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent.
5. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
6. Product Data: For recycled content, indicating percentage of postconsumer and preconsumer recycled content and cost.

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2.3 CABINET HARDWARE AND ACCESSORIES

- A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening.
- B. Back-Mounted Pulls: BHMA A156.9, B02011.
  - 1. Basis-of-Design Product: “DP105C/4” by Doug Mockett and Co.
- C. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- D. Shelf Rests: BHMA A156.9, B04013; two-pin plastic with shelf hold-down clip.
- E. Drawer Slides: BHMA A156.9.
  - 1. Grade 1 and Grade 2: Side mounted.
    - a. Type: Full extension.
    - b. Material: Epoxy-coated steel with polymer rollers.
  - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
- F. Slides for Sliding Glass Doors: BHMA A156.9, B07063; aluminum.
- G. Door and Drawer Silencers: BHMA A156.16, L03011.
- H. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
  - 1. Color: To be selected from manufacturer’s full range.
- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  - 1. Satin Nickel ANSI/BHMA 646.
- J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

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1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.5 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

### 3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
  1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
  2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

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3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

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SECTION 066500 – SIMULATED WOOD TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Cellular PVC trim boards for:
  - a. Corner boards.
  - b. Soffits.
  - c. Fascia.
  - d. Door trim.
  - e. Window trim.

- B. Related Requirements:

- 1. Section 062000 "Finish Carpentry."

1.3 REFERENCES

- A. ASTM D792 – Density and Specific Gravity of Plastics by Displacement.
- B. ASTM D570 – Water Absorption of Plastics.
- C. ASTM D638 – Tensile Properties of Plastics.
- D. ASTM D790 – Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- E. ASTM D1761 – Mechanical Fasteners in Wood.
- F. ASTM D5420 – Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by means of a Striker Impacted by a Falling Weight.
- G. ASTM D256 – Determining the Pendulum Impact Resistance of Plastics.
- H. ASTM D696 – Coefficient of Linear Thermal Expansion of Plastics Between -30 deg C and 30 deg C with a Vitreous Silica Dilatometer.
- I. ASTM D635 – Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

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- J. ASTM E84 – Surface Burning Characteristics of Building Materials.
- K. ASTM D648 – Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
- L. ASTM D3679 – Standard Specification for Rigid Poly Vinyl Chloride (PVC) Siding.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: Manufacturer’s data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation instructions and methods.
  - 4. Code compliance reports.
- C. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
  - 1. List of proposed materials demonstration that each material was extracted, harvested or recovered, as well as manufactured within 500 miles of the project site.
- D. Samples: For each product specified, two samples, minimum size 6 inches long, representing actual product, color, finish.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer with a minimum of 15 years producing PVC trim products.
- B. Installer Qualifications: Installer with a minimum of 3 years’ experience with the installation of PVC trim products.
- C. Allowable Tolerances:
  - 1. Variation in component length: -0.00 / +1.00”
  - 2. Variation in component width:  $\pm 1/16$ ”
  - 3. Variation in component thickness:  $\pm 1/16$ ”
  - 4. Variation in component edge cut:  $\pm 2$  degrees
  - 5. Variation in Density: -0% + 10%
- D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Finish areas designed by Architect.
  - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by architect.
  - 3. Refinish mock-up area as required to produce acceptable work.

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4. Accepted mock-ups shall be comparison standard for remaining work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Trim materials should be stored on a flat and level surface on a full shipping pallet. Handle materials to prevent damage to product edges and corners.
- B. Store materials under a protective covering to prevent jobsite dirt and residue from collecting on the boards.

1.7 WARRANTY

- A. Provide manufacturer's Limited Lifetime warranty against defects in manufacturing that cause the products to rot, corrode, delaminate, or excessively swell from moisture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable products: AZEK® Trimboards manufactured by The AZEK® Company, which is located at: 888 N Keyser Ave Scranton, PA 18508.
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 016000, "Product Requirements."

2.2 MATERIALS

- A. PVC: Free foam cellular PVC material with a small cell microstructure and density of 0.55 grams/cm<sup>3</sup>.
- B. Material shall have a minimum physical and performance properties specified in the following Section C.
- C. Performance and physical characteristic requirements:

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Property	Units	Value	ASTM Method
PHYSICAL			
Density	g/cm3	0.55	D 792
Water Absorption	%	0.15	D 570
MECHANICAL			
Tensile Strength	psi	2256	D 638
Tensile Modulus	psi	144,000	D 638
Flexural Strength	psi	3329	D 790
Flexural Modulus	psi	144,219	D 790
Nail Hold	Lbf/in of penetration	35	D 1761
Screw Hold	Lbf/in of penetration	680	D 1761
Staple Hold	Lbf/in of penetration	180	D 1761
Gardner Impact	in-lbs	103	D 5420
Charpy Impact (@23 deg C)	ft-lbs	4.5	D 256
THERMAL			
Coefficient of Linear Expansion	in/in/deg F	3.2 x 10-5	D 696
Burning Rate	in/min	No burn when flame removed	D 635
Flame Spread Index	--	25	E 84
Heat Deflection Temp 264 psi	deg F	150	D 648
Oil Canning (@140 deg F)	deg F	Passed	D 648

## 2.3 SIMULATED WOOD TRIM

- A. PVC Trimboard: AZEK® Trimboard with Sealed Edge, designed with an natural appearance to compliment fiber cement and natural cedar.
  1. Size:
    - a. Nominal Width: As indicated on Drawings.
    - b. Nominal Thickness: As indicated on Drawings.
    - c. Length: As indicated on Drawings.
  2. Finish:
    - a. Traditional/Smooth finish.
    - b. Reversible with Traditional (Smooth)/Frontier (Woodgrain) finish.
- B. PVC Cornerboard: AZEK® Corners: Folded, 90-degree, one-piece assembly produced with a Traditional or Frontier appearance to compliment fiber cement and natural cedar.
  1. Size:
    - a. Nominal Corner Size: As indicated on Drawings.
    - b. Nominal Thickness: 5/4 inch (1 inch actual size).
    - c. Length: As indicated on Drawings.



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2. Finish:
  - a. Traditional/Smooth.
  - b. Frontier (Woodgrain).

2.4 SIMULATED WOOD TRIM

- A. PVC Trimboard: AZEK® Rabbeted Trimboard, designed with 3/4-inch pocket to accommodate any siding product including fiber cement, cedar, hardboard and vinyl.

1. Size:
  - a. Nominal Width: As indicated on Drawings.
  - b. Nominal Thickness: 5/4 inch (1 inch actual size).
  - c. Length: 18 feet.

2. Finish:
  - a. Traditional/Smooth finish.
  - b. Frontier (Woodgrain) finish.

- B. PVC Cornerboard: AZEK® Rabbeted Corners: Folded, 90-degree, one-piece corner assembly designed with 3/4-inch pocket to accommodate any siding product including fiber cement, cedar, hardboard and vinyl.

1. Size:
  - a. Nominal Corner Width: As indicated on Drawings.
  - b. Nominal Thickness: 5/4 (1 inch actual size)
  - c. Length: As indicated on Drawings.

- C. PVC Skirtboard: AZEK® 1-Piece Skirtboard. Precut trim providing grade clearance and starter strip for fiber cement sidings as well as composite sidings:

1. Size:
  - a. Nominal Width: As indicated on Drawings.
  - b. Length: 18 feet

2. Finish:
  - a. Traditional/Smooth finish.
  - b. Frontier (Woodgrain) finish.

- D. PVC Skirtboard: AZEK® Universal Skirt Board, A two-piece reversible trimboard with integrated z-flashing and starter.

1. Size:
  - a. Nominal Width: As indicated on Drawings.
  - b. Length: 18 feet

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2. Finish:
  - a. Traditional/Smooth finish.
  - b. Frontier (Woodgrain) finish.

E. PVC Bandboard/Skirtboard: AZEK® Integrated Drip Edge, A two-piece reversible trimboard with integrated z-flashing.

1. Size:
  - a. Nominal Width: As indicated on Drawings.
  - b. Length: 18 feet
2. Finish:
  - a. Traditional/Smooth finish.
  - b. Frontier (Woodgrain) finish.

## 2.5 ACCESSORY PRODUCTS

A. Fasteners:

1. AZEK® Cortex for Trim.
2. Use fasteners design for wood trim and wood siding (thinner shank, blunt point, full round head) with AZEK®.
3. Use a highly durable fastener such as stainless steel or hot-dipped galvanized.
4. Staples, small brads and wire nails must not be used as fastening members.
5. The fasteners should be long enough to penetrate the solid wood substrate a minimum of 1-1/2”.
6. Standard nail guns work well with AZEK® trim products.
7. Use 2 fasteners per every framing member for trimboard applications. Trimboards 12” or wider, as well as sheets, will require additional fasteners.
8. Fasteners must be installed no more than 2” from the end of each board.
9. AZEK® should be fastened into a flat, solid substrate. Fastening AZEK® into hollow or uneven areas must be avoided.
10. Pre-drilling is typically not required unless a large fastener is used or product is installed in low temperatures.
11. 3/8” and 1/2” sheet product is not intended to be ripped into trim pieces. These profiles must be glued to a substrate and mechanically fastened.

B. Adhesives:

1. Glue all AZEK® to AZEK® joints such as window surrounds, long fascia runs, etc. with AZEK® Adhesive, a cellular PVC cement, to prevent joint separation.
2. The glue joint should be secured with a fastener and/or fastened on each side of the joint to allow adequate bonding time.
3. AZEK® Adhesive has a working time of 10 minutes and will be fully cured in 24 hours.
4. If standard PVC cements are used, keep in mind these products typically cure quickly which will result in limited working time and may reduce adhesive strength.
5. Surfaces to be glued should be smooth, clean and in complete contact with each other.

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6. To bond AZEK® to other substrates, various adhesives may be used. Consult adhesive manufacturer to determine suitability.

C. Sealants:

1. Use urethane, polyurethane or acrylic based sealants without silicone.

## 2.6 FINISHES

- A. AZEK products do not require paint for protection but may be painted to achieve a custom color.

B. Preparation:

1. No special surface preparations are required prior to painting – sanding is not necessary for paint adhesion.
2. Surface must be clean and dry.
3. Use a 100% acrylic latex paint with a Light Reflective Value (LRV) of 55 or higher.
4. Follow the paint manufacturer's recommendations to apply.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Manufacturer Instructions:

1. Comply with manufacturer's product catalog installation instructions and product technical bulletin instructions.

B. Cutting:

1. AZEK® products can be cut using the same tools used to cut lumber.
2. Carbide tipped blades designed to cut wood work well. Avoid fine tooth metal cutting blades.
3. Rough edges from cutting may be caused by excessive friction, poor board support, or worn or improper tooling.

C. Cutting:

1. AZEK® products can be drilled using the same tools used to drill lumber.
2. Drilling AZEK® products is similar to drilling a hardwood. Care should be taken to avoid frictional heat build-up.
3. Use standard woodworking drills. Do not use drills made for normal rigid PVC.
4. Periodic removal of AZEK® shavings from the drill hole may be necessary.

D. Milling:

1. AZEK® products can be milled using standard milling machines used to mill lumber.
2. Relief Angle 20 deg to 30 deg.

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3. Cutting speed to be optimized with the number of knives and feed rate.

E. Routing:

1. AZEK® products can be routed using standard router bits and the same tools used to rout lumber.
2. Carbide tipped router bits are recommended.

F. Edge Finishing:

1. Edges can be finished by sanding, grinding, or filing with traditional woodworking tools.

G. Nail Location:

1. Use 2 fasteners per every framing member for trimboard applications.
2. Trimboards over 12” or wider, as well as sheets, will require additional fasteners.
3. Fasteners must be installed no more than 2” from the end of each board.

H. Thermal Expansion and Contraction:

1. AZEK® products expand and contract with changes in temperature.
2. Properly fastening AZEK® material along its entire length will minimize expansion and contraction.
3. When properly fastened, allow 1/8” per 18 foot of AZEK® product for expansion and contraction.
4. Joints between pieces of AZEK® should be glued to eliminate joint separation. When gaps are glued on a long run of AZEK®, allow expansion and contraction at ends of the run.

END OF SECTION

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SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Modified bituminous sheet waterproofing.
  - 2. Molded-sheet drainage panels.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
  - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- C. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- D. Samples: For each exposed product and for each color and texture specified, including the following products:
  - 1. 8-by-8-inch square of waterproofing and flashing sheet.
  - 2. 4-by-4-inch square of drainage panel.

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1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For Installer.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
  - 1. Build for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.
    - a. Size: 100 sq. ft. in area.
    - b. Description: Each type of wall installation.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
  - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Carlisle Coatings & Waterproofing Inc.
- b. GCP Applied Technologies Inc. (formerly Grace Construction Products).
- c. Polyguard Products, Inc.
- d. W. R. Meadows, Inc.

2. Physical Properties:

- a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
- b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
- c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970/D 1970M.
- d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836/C 836M.
- e. Puncture Resistance: 40 lbf minimum; ASTM E 154/E 154M.
- f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
- g. Water Vapor Permeance: 0.05 perm maximum; ASTM E 96/E 96M, Water Method.
- h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.

3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 ACCESSORIES FOR WATERPROOFING

- A. Furnish accessory materials as recommended in writing by waterproofing manufacturer for intended use and compatibility with sheet waterproofing.

1. Furnish liquid-type accessory materials that comply with VOC limits of authorities having jurisdiction.

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- B. Primer: Liquid waterborne primer as recommended in writing for substrate by sheet waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner as recommended in writing for substrate by sheet waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- F. Metal Termination Bars: Aluminum or stainless steel bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

## 2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft.
  - 1. Manufacturers: Subject to compliance with requirements and acceptable to modified bituminous sheet waterproofing manufacturer, provide products by one of the following:
    - a. American Hydrotech, Inc.
    - b. BASF Corporation; Construction Systems.
    - c. Carlisle Coatings & Waterproofing Inc.
    - d. CETCO, a Minerals Technologies company.
    - e. GCP Applied Technologies Inc. (formerly Grace Construction Products).
    - f. Insulation Solutions, Inc.
    - g. Polyguard Products, Inc.
    - h. Urethane Polymers International, Inc.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.
  - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
  - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.



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- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
  - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
  - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
    - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

### 3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and per recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

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1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- E. Seal edges of sheet-waterproofing terminations with mastic.
- F. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

3.4 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation before installing drainage panels.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish reports to Architect at the start, mid-point, and completion of the waterproofing membrane installation.
- B. Waterproofing will be considered defective if it does not pass inspections.
- C. Prepare test and inspection reports.

3.6 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

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- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Molded (expanded) polystyrene foam-plastic board insulation.
3. Polyisocyanurate foam-plastic board insulation.
4. Wood-fiber blanket insulation.
5. Composite polyisocyanurate foam-plastic board insulation.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
2. Section 061600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
3. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
4. Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for insulation specified as part of roofing construction.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating percentage of postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Environmental Product Declaration: For each product.
5. Environmental Product Declaration: For each product.
6. Health Product Declaration (HPD): Provide documentation indicating that manufacturer has screened and publicly provided ingredient disclosure to 1000 ppm, and has developed an action plan to mitigate known hazards.
7. Product Data: For adhesives, indicating VOC content.
8. Laboratory Test Reports: For insulation, indicating compliance with the VOC emissions evaluation.
9. Laboratory Test Reports: For insulation, indicating compliance with requirements for

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low-emitting materials.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
  - 1. For blown-in or sprayed fiberglass and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
  - 2. Sign, date, and post the certification in a conspicuous location on Project site.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Research Reports: For foam-plastic insulation, from ICC-ES.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
  - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than Class A, 25 and 450 when tested in accordance with ASTM E84.
- B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

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- C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
- E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.
- F. Verify insulation complies with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- G. Verify insulation complies with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify formaldehyde emissions do not exceed 16.5 mcg/cu. m or 13.5 ppb, whichever is less, except for insulation manufactured without formaldehyde.
- H. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 15 percent.
  - 1. Verify adhesives have a VOC content of 70 g/L or less.
  - 2. Verify adhesive complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (XPS)

- A. Extruded Polystyrene Board Insulation, Type VII : ASTM C578, Type VII, **60 psi** minimum compressive strength.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. DiversiFoam Products
    - b. DuPont de Nemours, Inc.
    - c. Kingspan Insulation LLC
    - d. Owens Corning
    - e. The Dow Chemical Company

2.3 MOLDED (EXPANDED) POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (EPS)

- A. Molded (Expanded) Polystyrene Board Insulation, Type XV : ASTM C578, Type XV, **60 psi** minimum compressive strength.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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- a. Alleguard (formerly Amvic Building System)
- b. Atlas Molded Products, a division of Atlas Roofing Corporation
- c. Insulfoam; a Carlisle Company
- d. Plymouth Foam, an Altor Solutions Company

2.4 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

- A. Polyisocyanurate Board Insulation, Glass-Fiber-Mat Faced : ASTM C1289, glass-fiber-mat faced, Type II, Class 2.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Atlas Polyiso Roof and Wall Insulation
    - b. Carlisle Coatings & Waterproofing Inc
    - c. Elevate; Holcim Building Envelope
    - d. Johns Manville; a Berkshire Hathaway company
    - e. Rmax, A Business Unit of Sika Corporation

2.5 COMPOSITE POLYISOCYANURATE FOAM-PLASTIC BOARD

- A. Polyisocyanurate Board, Glass-Fiber-Mat Faced with Bonded 5/8-inch Fire Retardant Treated Plywood (FRTP) on One Face (Wall Insulation): ASTM C 1289, Type 5.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Atlas Roofing Corporation.
    - b. Carlisle Coatings & Waterproofing Inc.
    - c. Hunter Panels.
    - d. Rmax, Inc.
  - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.6 WOOD-FIBER BLANKET INSULATION

- A. Basis-of-Design Product: Subject to compliance with requirements, provide TimberHP; TimberBatt.
- B. Wood-Fiber Blanket Insulation, ASTM 84 Class A Flame and Smoke Spread, R-4 per inch.

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2.7 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
  - 1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
- C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
- E. Insulation Fastener Accessories: Provide double-pointed weld pins, lagging pins, quilting pins, duct liner pins, insulation hangers, specialty washers, special caps, j-hooks, capacitor discharge annular weld pins, capacitor discharge acoustical lagging pins, and other accessory materials that are recommended in writing by insulation fastener manufacturer to produce complete insulation supports.

2.8 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
- B. Miscellaneous Application Accessories:
  - 1. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
  - 2. Crack Sealer: Closed-cell insulating foam in aerosol dispenser recommended in writing by insulation manufacturer for filling gaps in board insulation.



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PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or those that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products, applications and applicable codes.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive in accordance with manufacturer's written instructions.
- B. On horizontal surfaces, loosely lay insulation units in accordance with manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
  - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive in accordance with anchor manufacturer's written instructions.
  - 2. Space anchors in accordance with insulation manufacturer's written instructions for insulation type, thickness, and application.

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- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing in accordance with manufacturer's written instructions.

### 3.5 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended in writing by manufacturer.
  - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

### 3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members in accordance with the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
  - 1. Detailing Foam Insulation for Voids: Apply in accordance with manufacturer's written instructions.

### 3.7 INSTALLATION OF BOARD INSULATION

- A. Install board insulation in accordance with manufacturer's written instructions per project applications and conditions.

### 3.8 INSTALLATION OF COMPOSITE INSULATION BOARD

- A. Composite Foam-Plastic Board Wall Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer, with edges butted tightly in both directions. Press units firmly against inside substrates. Screw to cold-formed metal framing in manufacturer's recommended fastening pattern.

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3.9 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

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SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Closed-cell spray polyurethane foam.
- B. Related Requirements:
  - 1. Section 072100 "Thermal Insulation" for foam-plastic board insulation.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For Installer.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

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PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

- A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 2.0 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. BASF Corporation; SPF.
    - b. CertainTeed Corporation.
    - c. Dow Chemical Company (The).
    - d. Gaco Western LLC.
    - e. Henry Company.
    - f. Icynene Inc.
    - g. Johns Manville; a Berkshire Hathaway company.
    - h. NCFI Polyurethanes; a division of Barnhardt Manufacturing Company.
    - i. SWD Urethane Company.
    - j. Volatile Free, Inc.
  2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 75 or less.
    - b. Smoke-Developed Index: 450 or less.

2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
- B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.

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- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
- E. Cavity Walls: Install into cavities to thickness indicated on Drawings.
- F. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION

SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes self-adhering, vapor-retarding, modified bituminous sheet air barriers.
- B. Related Requirements:
  - 1. Section 061613.53 “Insulating Air & Moisture Resistant Sheathing.”
  - 2. Section 072726 “Fluid-Applied Membrane Air Barriers” for Contractor’s optional air barrier system.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.

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1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.
- C. Shop Drawings: For air-barrier assemblies.
1. Show locations and extent of air barrier materials, accessories, and assemblies specific to Project conditions.
  2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
  3. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
- C. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.
- D. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- E. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
  1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.
  1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
    - a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
    - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.



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- c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.
- B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
  1. Air-Leakage-Location Testing: Mockups will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
  2. Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate according to ASTM E 783.
  3. Adhesion Testing: Mockups will be tested for required air-barrier adhesion to substrate according to ASTM D 4541.
  4. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
  1. Protect substrates from environmental conditions that affect air-barrier performance.
  2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

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2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

2.3 SELF-ADHERING SHEET AIR BARRIER

- A. Modified Bituminous Sheet: 40-mil- thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick, cross-laminated polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits.
  - 1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. [Carlisle Coatings & Waterproofing Inc](#); CCW-705 LT.
    - b. [Henry Company](#); Blueskin SA LT.
    - c. [Tremco Incorporated](#); ExoAir 110/110LT.
    - d. [W. R. Meadows, Inc](#); Air-Shield.
  - 2. Physical and Performance Properties:
    - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
    - b. Tensile Strength: Minimum 500 psi; ASTM D 412, Die C.
    - c. Ultimate Elongation: Minimum 300 percent; ASTM D 412, Die C.
    - d. Puncture Resistance: Minimum 50 lbf; ASTM E 154/E 154M.
    - e. Water Absorption: Maximum 0.12 percent weight gain after 48-hour immersion at 70 deg F; ASTM D 570.
    - f. Vapor Permeance: Maximum 0.05 perm; ASTM E 96/E 96M, Desiccant Method.
    - g. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested according to ASTM D 4541 as modified by ABAA.
    - h. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
    - i. UV Resistance: Can be exposed to sunlight for 30 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier

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assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
  - 1. VOC Content: 100 g/L or less.
  - 2. Low-Emitting Materials: Products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.
- D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; Dow Corning® 123 Silicone Seal.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.; US11000 UltraSpan.
    - c. Pecora Corporation; Sil-Span.
    - d. Tremco Incorporated; Spectrem Simple Seal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
  - 3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

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- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge isolation joints, common expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

### 3.3 INSTALLATION

- A. Install materials according to air-barrier manufacturer's written instructions and details and according to recommendations in ASTM D 6135 to form a seal with adjacent construction and ensure continuity of air and water barrier.
  - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F.
  - 2. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
- B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.
- C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.
- D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
  - 1. Apply sheets in a shingled manner to shed water.
  - 2. Roll sheets firmly to enhance adhesion to substrate.
- E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.

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- F. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch- wide, transition strip.
- G. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- H. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
  - 1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
- I. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- J. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.
- K. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- L. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply preformed silicone extension so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
  - 1. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air barrier.
- M. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- N. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.
- O. Do not cover air barrier until it has been tested and inspected by testing agency.
- P. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### 3.4 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

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- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections include the following:
  - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
  - 2. Continuous structural support of air-barrier system has been provided.
  - 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
  - 4. Site conditions for application temperature and dryness of substrates have been maintained.
  - 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
  - 6. Surfaces have been primed.
  - 7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
  - 8. Termination mastic has been applied on cut edges.
  - 9. Air barrier has been firmly adhered to substrate.
  - 10. Compatible materials have been used.
  - 11. Transitions at changes in direction and structural support at gaps have been provided.
  - 12. Connections between assemblies (air barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
  - 13. All penetrations have been sealed.
- D. Tests: As determined by testing agency from among the following tests:
  - 1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
  - 2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783.
  - 3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.
- E. Air barriers will be considered defective if they do not pass tests and inspections.
  - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
  - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- G. Prepare test and inspection reports.

### 3.5 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

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1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
  2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Vapor-retarding, fluid-applied air barriers.
- B. Related Requirements:
  - 1. Section 061613.53 "Insulating Air & Moisture Resistant Sheathing."
  - 2. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.



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1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

C. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
- C. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- D. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- E. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
  1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.
  1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
    - a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
    - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.

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- c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.
- B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
  1. Air-Leakage-Location Testing: Mockups will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
  2. Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate according to ASTM E 783.
  3. Adhesion Testing: Mockups will be tested for required air-barrier adhesion to substrate according to ASTM D 4541.
  4. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
  1. Protect substrates from environmental conditions that affect air-barrier performance.
  2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

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2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

- A. High-Build, Vapor-Retarding Air Barrier: Modified bituminous or synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.

1. Modified Bituminous Type:

- a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Carlisle Coatings & Waterproofing Inc; Barriseal S.
- 2) Henry Company; Air-Bloc 06 WB.
- 3) Tremco Incorporated; ExoAir 120.
- 4) W. R. Meadows, Inc; Air-Shield LM (All Season).

2. Synthetic Polymer Type:

- a. Products: Subject to compliance with requirements, provide the following:

- 1) GCP Applied Technologies Inc. (formerly Grace Construction Products); Perm-A-Barrier Liquid.

3. Physical and Performance Properties:

- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
- b. Vapor Permeance: Maximum 0.1 perm; ASTM E 96/E 96M, Desiccant Method.
- c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.
- d. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested according to ASTM D 4541.
- e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- f. UV Resistance: Can be exposed to sunlight for 30 days according to manufacturer's written instructions.

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2.4 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.
- D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; Dow Corning® 123 Silicone Seal.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.; US11000 UltraSpan.
    - c. Pecora Corporation; Sil-Span.
    - d. Tremco Incorporated; Spectrem Simple Seal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
  - 3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

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- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge isolation joints, expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

### 3.3 ACCESSORIES INSTALLATION

- A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
  - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
  - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply preformed silicone extrusion so that a minimum of 3 inches of

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coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air barrier material.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

### 3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
  3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.
1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in one or more equal coats.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

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3.5 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections include the following:
  - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
  - 2. Air-barrier dry film thickness.
  - 3. Continuous structural support of air-barrier system has been provided.
  - 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
  - 5. Site conditions for application temperature and dryness of substrates have been maintained.
  - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
  - 7. Surfaces have been primed, if applicable.
  - 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
  - 9. Termination mastic has been applied on cut edges.
  - 10. Strips and transition strips have been firmly adhered to substrate.
  - 11. Compatible materials have been used.
  - 12. Transitions at changes in direction and structural support at gaps have been provided.
  - 13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
  - 14. All penetrations have been sealed.
- D. Tests: As determined by testing agency from among the following tests:
  - 1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
  - 2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783.
  - 3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.
- E. Air barriers will be considered defective if they do not pass tests and inspections.
  - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
  - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- G. Prepare test and inspection reports.

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3.6 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
  - 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
  - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION



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SECTION 073113 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Asphalt shingles.
- 2. Underlayment.
- 3. Ridge vents.
- 4. Metal flashing and trim.

- B. Related Requirements:

- 1. Section 072100 "Thermal Insulation" for composite nail base roof insulation.

1.3 DEFINITIONS

- 1.

- B. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Samples: For each exposed product and for each color and texture specified.
  - 1. Asphalt Shingles: Full size.
  - 2. Ridge and Hip Cap Shingles: Full size.
  - 3. Ridge Vent: 12-inch-long Sample.

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1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For Installer.
- C. Product Test Reports: For each type of asphalt shingle and underlayment product indicated, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- D. Evaluation Reports: For synthetic underlayment and high-temperature, self-adhering sheet underlayment, from ICC-ES or other testing and inspecting agency acceptable to authorities having jurisdiction, indicating that product is suitable for intended use under applicable building codes.
- E. Sample Warranty: For manufacturer's warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For asphalt shingles to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture according to manufacturer's written instructions.
- B. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.
- C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.
- D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

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1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Manufacturing defects.
  - 2. Material Warranty Period: Lifetime, limited transferable warranty.
  - 3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 110 mph for 15 years from date of Substantial Completion.
  - 4. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 15 years from date of Substantial Completion.
  - 5. Workmanship Warranty Period: Two years from date of Substantial Completion.
- B. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of asphalt-shingle roofing that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance according to ASTM E 108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Laminated-Strip Asphalt Shingles: ASTM D 3462/D 3462M, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "LANDMARK PRO", CertainTeed Corporation, or comparable product by one of the following:
    - a. CertainTeed Corporation.
    - b. GAF.
    - c. Owens Corning.
  - 2. Butt Edge: Crenelated cut.
  - 3. Strip Size: Manufacturer's standard.
  - 4. Algae Resistance: Granules resist algae discoloration.
  - 5. Color and Blends: As selected by Architect from manufacturer's full range.

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- B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.3 UNDERLAYMENT MATERIALS

- A. Glass-Reinforced Felt: ASTM D 6757, glass-reinforced, asphalt-saturated organic felt.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Atlas EPS; a Division of Atlas Roofing Corporation.
- b. CertainTeed Corporation.
- c. CertainTeed Roofing Corporation.
- d. Owens Corning.

- B. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Atlas EPS; a Division of Atlas Roofing Corporation.
- b. CertainTeed Corporation.
- c. GAF.
- d. GCP Applied Technologies Inc. (formerly Grace Construction Products).
- e. Owens Corning.
- f. SDP Advanced Polymer Products Inc.
- g. SystemComponents Corporation.
- h. Tamko Building Products, Inc.

- C. Self-Adhering Sheet Underlayment, Granular Surfaced: ASTM D 1970/D 1970M, minimum of 60-mil thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Atlas EPS; a Division of Atlas Roofing Corporation.
- b. Carlisle Residential; a division of Carlisle Construction Materials.
- c. CertainTeed Corporation.
- d. GAF.
- e. GCP Applied Technologies Inc. (formerly Grace Construction Products).
- f. Henry Company.
- g. Owens Corning.
- h. Tamko Building Products, Inc.

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2.4 RIDGE VENTS

- A. Rigid Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent for use under ridge shingles.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide “9” Filtered Class A Fire-Rated Ridge Vent”, CertainTeed Corporation; or comparable product by one of the following:
    - a. Air Vent, Inc.; a Gibraltar Industries company.
    - b. Benjamin Obdyke, Incorporated.
    - c. Cor-A-Vent, Inc.
    - d. GAF.
    - e. Lomanco, Inc.
    - f. Owens Corning.
    - g. Tapco Group (The); Mid-America Siding Components.
  - 2. Minimum Net Free Area: 16 sq. in./lf.
  - 3. Width: 9-inches.
  - 4. Thickness: 1-inch.
  - 5. Features:
    - a. Nonwoven geotextile filter strips.
    - b. External deflector baffles.

2.5 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.
- B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch-diameter, sharp-pointed, with a minimum 3/8-inch-diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through OSB or plywood sheathing.
  - 1. Shank: Barbed.
  - 2. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- C. Felt-Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch minimum diameter.
- D. Synthetic-Underlayment Fasteners: As recommended in writing by synthetic-underlayment manufacturer for application indicated.

2.6 METAL FLASHING AND TRIM

- A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
  - 1. Sheet Metal: Zinc-tin alloy-coated steel.

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- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.
  - 1. Apron Flashings: Fabricate with lower flange a minimum of 4 inches over and 4 inches beyond each side of downslope asphalt shingles and 6 inches up the vertical surface.
  - 2. Step Flashings: Fabricate with a headlap of 2 inches and a minimum extension of 4 inches over the underlying asphalt shingle and up the vertical surface.
  - 3. Cricket or Backer Flashings: Fabricate with concealed flange extending a minimum of 24 inches beneath upslope asphalt shingles and 6 inches beyond each side of roof penetrations and 6 inches above the roof plane.
  - 4. Drip Edges: Fabricate in lengths not exceeding 10 feet with 2-inch roof-deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge.
- C. Vent Pipe Flashings: ASTM B 749, Type L51121, at least 1/16 inch thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 4 inches from pipe onto roof.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provisions have been made for flashings and penetrations through asphalt shingles.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 UNDERLAYMENT INSTALLATION

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with felt-underlayment nails.
  - 1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches in direction that sheds water. Lap ends of felt not less than 6 inches over self-adhering sheet underlayment.

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2. Install fasteners at no more than 36 inches o.c.
- C. Synthetic Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides and ends and treat laps as recommended in writing by manufacturer. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer. Fasten according to manufacturer's written instructions. Cover underlayment within period recommended in writing by manufacturer.
1. Install in single layer on roofs sloped at 4:12 and greater.
- D. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.
1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.
  2. Eaves: Extend from edges of eaves 24 inches beyond interior face of exterior wall.
  3. Rakes: Extend from edges of rake 24 inches beyond interior face of exterior wall.
  4. Valleys: Extend from lowest to highest point 18 inches on each side.
  5. Hips: Extend 18 inches on each side.
  6. Ridges: Extend 24 inches on each side without obstructing continuous ridge vent slot.
  7. Sidewalls: Extend beyond sidewall 24 inches, and return vertically against sidewall not less than 8 inches.
  8. Dormers, Chimneys, Skylights, and Other Roof-Penetrating Elements: Extend beyond penetrating element 24 inches, and return vertically against penetrating element not less than 8 inches.
  9. Roof Slope Transitions: Extend 24 inches on each roof slope.
- E. Concealed Valley Lining: For closed-cut valleys. Comply with NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems." Install underlayment centered in valley and fastened to roof deck.
1. Lap roof-deck underlayment over valley underlayment at least 6 inches.
  2. Install a 36-inch-wide strip of granular-surfaced valley lining, with granular-surface face up, centered in valley. Lap ends of strips at least 12 inches in direction to shed water, and seal with asphalt roofing cement. Fasten to roof deck.

### 3.3 METAL FLASHING INSTALLATION

- A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Apron Flashings: Extend lower flange over and beyond each side of downslope asphalt shingles and up the vertical surface.

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- C. Step Flashings: Install with a headlap of 2 inches and extend over the underlying asphalt shingle and up the vertical surface. Fasten to roof deck only.
- D. Cricket or Backer Flashings: Install against the roof-penetrating element extending concealed flange beneath upslope asphalt shingles and beyond each side.
- E. Rake Drip Edges: Install rake drip-edge flashings over underlayment and fasten to roof deck.
- F. Eave Drip Edges: Install eave drip-edge flashings below underlayment and fasten to roof sheathing.
- G. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

### 3.4 ASPHALT-SHINGLE INSTALLATION

- A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install manufacturer's recommended starter strip system, required to meet specified warranty, along lowest roof edge, consisting of an asphalt-shingle strip with self-sealing strip face up at roof edge.
  - 1. Extend asphalt shingles 1/2 inch over fasciae at eaves and rakes.
  - 2. Install starter strip along rake edge.
- C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Fasten asphalt-shingle strips with a minimum of four roofing nails located according to manufacturer's written instructions.
- E. Closed-Cut Valleys: Extend asphalt-shingle strips from one side of valley 12 inches beyond center of valley. Use one-piece shingle strips without joints in valley. Fasten with extra nail in upper end of shingle. Install asphalt-shingle courses from other side of valley and cut back to a straight line 2 inches short of valley centerline. Trim upper concealed corners of cut-back shingle strips.
  - 1. Do not nail asphalt shingles within 6 inches of valley center.
  - 2. Set trimmed, concealed-corner asphalt shingles in a 3-inch-wide bed of asphalt roofing cement.
- F. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.
- G. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.



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1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

### 3.5 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS **<Insert name>** of **<Insert address>**, herein called the "Roofing Installer," has performed roofing and associated work ("the work") on the following project:
1. Owner: **<Insert name of Owner>**.
  2. Address: **<Insert address>**.
  3. Building Name/Type: **<Insert information>**.
  4. Address: **<Insert address>**.
  5. Area of the Work: **<Insert information>**.
  6. Acceptance Date: **<Insert date>**.
  7. Warranty Period: **<Insert time>**.
  8. Expiration Date: **<Insert date>**.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant the work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of the work as are necessary to correct faulty and defective work and as are necessary to maintain the work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to the work and other parts of the building, and to building contents, caused by:
    - a. Lightning;
    - b. Peak gust wind speed exceeding **<Insert wind speed>** mph;
    - c. Fire;
    - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    - f. Vapor condensation on bottom of roofing; and
    - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
  2. When the work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  3. Roofing Installer is responsible for damage to the work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of the work.
  4. During Warranty Period, if Owner allows alteration of the work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with

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penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of the alterations, but only to the extent the alterations affect the work covered by this Warranty. If Owner engages Roofing Installer to perform the alterations, Warranty shall not become null and void unless Roofing Installer, before starting the alterations, notified Owner in writing, showing reasonable cause for claim, that the alterations would likely damage or deteriorate the work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a use or service more severe than originally specified, this Warranty shall become null and void on date of the change, but only to the extent the change affects the work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect the work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on the work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of the work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.

1. Authorized Signature: **<Insert signature>**.
2. Name: **<Insert name>**.
3. Title: **<Insert title>**.

END OF SECTION

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SECTION 074646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes fiber-cement siding and stand-off wall framing system.
- B. Related Requirements:
  - 1. Section 061000 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.

1.3 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Samples: For fiber-cement siding and reveal trim including related accessories, including color charts for factory finished panels and trim.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Certificates: For each type of fiber-cement siding and reveal trim.

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- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- D. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.
- E. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Build mockups for fiber-cement siding including accessories and stand-off wall system.
    - a. Size: Two panels wide by two panels vertical.
    - b. Include outside, intermediate and bottom reveal trim in the mockup.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including cracking and deforming.
    - b. Deterioration of materials beyond normal weathering.

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2. Warranty Period: 30 years from date of Substantial Completion.
3. Finish Warranty: Factory finished components shall have a finish warranty period of 15 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING (Panel Siding)

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
  1. Sole Source Product: Subject to compliance with requirements, provide "AWP 3030 Vintage Wood," Nichiha Fiber Cement.
- B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. Nominal Thickness: Not less than 5/8 inch.
- D. Panel Type: 17-7/8-inch by 119-5/16-inch panels with wood texture.
- E. Factory Finish: Manufacturer's standard factory primed and painted finish.
  1. Color: As selected by Architect from manufacturer's full range of colors.

2.3 FIBER-CEMENT SIDING (Lap Siding)

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
  1. Sole Source Product: Subject to compliance with requirements, provide "Hardie Plank," James Hardie.
- B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. Nominal Thickness: Not less than 5/16 inch.
- D. Siding Type: 12 inch by 144 inch smooth planks.
- E. Factory Finish:

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1. Color: Arctic White.

## 2.4 MISCELLANEOUS MATERIALS

- A. Stand-Off Wall System Metal Subframing: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections and recommended fasteners as required for support and alignment of fiber-cement panel system.
  1. Basis-of-Design System: Subject to compliance with requirements, provide "HCI System Rainscreen Attachment: Vertical RevealRail and Horizontal HCI-Girt;" Knight Wall Systems, or a comparable product.

## 2.5 ACCESSORIES

- A. Siding Accessories, General: Provide Corner Key, Open Outside Corner, H-Mold, J-Mold, Compression Joint, Inside Corner, ultimate clip system, venting trim, and other items as recommended by siding manufacturer for building configuration and as indicated on the Drawings.
  1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.
  2. Color: As selected by Architect from manufacturer's full range.
- B. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
  1. Finish for Aluminum Flashing: High-performance organic finish.
- C. Fasteners:
  1. For fastening to wood, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch into substrate.
  2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
  3. For fastening fiber cement, use hot-dip galvanized fasteners.
- D. Insect Screening for Venting Trim: Aluminum, 18-by-16 mesh.
- E. Finish: Manufacturer's standard factory finished panels, accessories, and fasteners.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and related accessories.

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- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. Install stand-off wall system metal framing complying with manufacturer's written recommendations.
- B. Install venting trim and insect screening at base and head of walls and as recommended by manufacturer for wall and window configuration.
- C. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
  - 1. Do not install damaged components.
  - 2. Install fasteners in spacing as required by manufacturer.
- D. Install joint sealants as specified in Section 079200 "Joint Sealants" as indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Accessory roofing system materials.
3. Vapor retarder.
4. Roof insulation and accessories.
5. Cover board.
6. Walkways.

B. Section contains the installation of sound-absorbing insulation strips in ribs of acoustical steel roof deck. Sound-absorbing insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Section 061000 "Rough Carpentry for wood nailers, curbs, and blocking.
2. Section 061719 "Cross Laminated Timber" for wood-based, structural-use roof deck panels.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
4. Section 077100 "Roof Specialties" for premanufactured copings and roof edge fasciae, roof edge flashings, and counterflashings.
5. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
6. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, Roofing System Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.



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3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, Roofing System Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data:
1. For each type of product.
- C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
1. Layout and thickness of insulation.
  2. Base and sheet flashings and membrane termination details.
  3. Flashing details at penetrations.
  4. Tapered insulation layout, thickness, and slopes.
  5. Roof plan showing orientation of roof deck and orientation of roofing membrane, fastening spacings, and pattern for corner, perimeter, and field-of-roof locations.

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6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Crickets, saddles, and tapered edge strips, including slopes.
8. Tie-in with adjoining wall system air barrier.

D. Samples for Verification: For the following products:

1. Roofing membrane and flashings of color required.
2. Walkways, of color required.

E. Wind-Uplift-Resistance Submittal: For roofing system, indicating compliance with wind-uplift performance requirements.

F. Sustainable Design Submittals:

1. Product Test Reports: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirements.
2. Health Product Declaration (HPD): Provide documentation confirming product compliance with one of the following:
  - a. Inventory or HPD to at least 0.01 percent by weight, with at least 95 percent assessed using GreenScreen Benchmark assessment.
  - b. Cradle to Cradle v3 certification with minimum Silver level of Material Health.
  - c. Living Product Challenge certification indicating achievement of Imperative 09, "Transparent Material Health."

## 1.5 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roofing membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
  - a. Submit evidence of complying with specified performance requirements.
2. Special Warranty Certificate: Signed by roofing membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roofing membrane and insulation, tests performed by an independent qualified testing agency, indicating compliance with specified requirements.

D. Research Reports: For components of roofing system, from an agency acceptable to authorities having jurisdiction showing compliance with specified performance requirements.

E. Field Test Reports:

1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

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- F. Field quality-control reports.
- G. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For roofing system.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, certified, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing system materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
  - 1. Protect stored liquid material from direct sunlight.
  - 2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.
  - 1. Store in a dry location.
  - 2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing system materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written installation instructions and warranty requirements.

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1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Special warranty to include all components of roofing system, such as vapor retarder, roof insulation, fasteners, adhesives, cover board, roofing membrane, base flashing sheet, walkways, and other components of roofing system.
  - 2. Warranty Period: 20 years from Date of Substantial Completion.
- B. Roofing System Installer's Warranty: Submit Roofing System Installer's warranty, on warranty form at end of this Section, signed by Roofing System Installer, covering the Work of this Section, including all components of roofing system, such as vapor retarder, roof insulation, fasteners, adhesives, cover board, roofing membrane, base flashing sheet, walkways and other components of roofing system.
  - 1. Warranty Period: Two years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain components for roofing system from roofing membrane manufacturer or manufacturer approved by roofing membrane manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and base flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and flashings to remain watertight.
  - 1. Accelerated Weathering: Roofing membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
  - 2. Impact Resistance: Roofing membrane to resist impact damage when tested in accordance with ASTM D3746/D3746M, ASTM D4272/D4272M, or the Resistance to Foot Traffic Test in FM Approvals 4470.
- B. Material Compatibility: Roofing system materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. Wind-Uplift Resistance: Design roofing system to resist the following wind-uplift pressures when tested in accordance with FM Approvals 4474, UL 580, or UL 1897:
- D. FM Approvals' RoofNav Listing: Roofing membrane, base flashings, and component materials to comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

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1. Fire/Windstorm Classification: Class 1A-90.
  2. Hail-Resistance Rating: FM 1-34 MH.
- E. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 32 or initial SRI not less than 39 when calculated in accordance with ASTM E1980, based on testing identical products by a qualified testing agency.
- F. Exterior Fire-Test Exposure: Class A; for application and roof slopes indicated; when tested by a qualified testing agency in accordance with ASTM E108 or UL 790.
1. Identify products with appropriate markings of applicable testing agency.
- G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.
1. Identify products with appropriate markings of applicable testing agency.

2.3 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING SYSTEM

- A. EPDM Roofing Membrane Sheet: ASTM D4637/D4637M, Type 1, nonreinforced, self-adhering EPDM sheet.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Carlisle Syntec Systems
    - b. Johns Manville; a Berkshire Hathaway company
    - c. Mule-Hide Products Co., Inc
    - d. Roofing Products International, Inc
    - e. Versico Roofing Systems; Carlisle Construction Materials
  2. Thickness: 60 mils, nominal.
  3. Exposed Face Color: Black.
  4. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 15 percent.

2.4 ACCESSORY ROOFING SYSTEM MATERIALS

- A. General: Accessory materials as recommended in writing by roofing membrane manufacturer for intended use and compatible with other roofing system components.
1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
  2. Verify adhesives and sealants comply with the following limits for VOC content:
    - a. Plastic Foam Adhesives: 50 g/L.
    - b. Gypsum Board and Panel Adhesives: 50 g/L.
    - c. Multipurpose Construction Adhesives: 70 g/L.
    - d. Fiberglass Adhesives: 80 g/L.
    - e. Contact Adhesives: 80 g/L.
    - f. PVC Welding Compounds: 510 g/L.
    - g. Other Adhesives: 250 g/L.

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- h. Single-Ply Roof Membrane Sealants: 450 g/L.
  - i. Nonmembrane Roof Sealants: 300 g/L.
  - j. Sealant Primers for Nonporous Substrates: 250 g/L.
  - k. Sealant Primers for Porous Substrates: 775 g/L.
- B. Base and Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as roofing membrane.
- C. Bonding Adhesive: Roofing membrane manufacturer's standard, water based.
- D. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch-wide minimum, butyl splice tape with release film.
- E. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.
- F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing system components to substrate; tested for required pullout strength, and acceptable to roofing membrane manufacturer.
- I. Miscellaneous Accessories: As recommended in writing by roofing membrane manufacturer.
- J. Bonding Adhesive: Manufacturer's standard, designed for adhering substrate board to roof deck.

2.5 VAPOR RETARDER

- A. Butyl-Rubber-Sheet Vapor Retarder, Self-Adhering: Polyethylene film laminated to layer of butyl rubber adhesive, minimum 30-mil total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor retarder manufacturer.

2.6 ROOF INSULATION AND ACCESSORIES

- A. General: Preformed roof insulation boards manufactured or approved by roofing membrane manufacturer, approved for use in FM Approvals' RoofNav listed roof assemblies.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2 coated glass-fiber facer on both major surfaces.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Atlas Polyiso Roof and Wall Insulation
    - b. Carlisle Syntec Systems

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- c. CertainTeed; SAINT-GOBAIN
    - d. Elevate; Holcim Building Envelope
    - e. GAF
    - f. Hunter Panels; a Carlisle company
    - g. Johns Manville; a Berkshire Hathaway company
  - 2. Compressive Strength: Grade 2, 20 psi.
  - 3. Size: 48 by 48 inches.
  - 4. Thickness:
    - a. Base Layer: As indicated on Drawings.
    - b. Upper Layer: As indicated on Drawings.
- C. Tapered Insulation: Provide factory-tapered insulation boards.
- 1. Material: Match roof insulation.
  - 2. Minimum Thickness: 1/4 inch.
  - 3. Slope:
    - a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
    - b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.
- D. General: Roof insulation accessories as recommended in writing by insulation manufacturer for intended use and compatibility with other roofing system components.
- 1. Insulation Adhesive: Insulation manufacturer's standard adhesive formulated to attach roof insulation to substrate and to another insulation layer as follows:
    - a. Modified asphaltic, asbestos-free, cold-applied adhesive.
    - b. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
    - c. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
  - 2. Verify adhesives and sealants comply with the following limits for VOC content:
    - a. Plastic Foam Adhesives: 50 g/L.
    - b. Gypsum Board and Panel Adhesives: 50 g/L.
    - c. Multipurpose Construction Adhesives: 70 g/L.
    - d. Fiberglass Adhesives: 80 g/L.
    - e. Contact Adhesives: 80 g/L.
    - f. PVC Welding Compounds: 510 g/L.
    - g. Other Adhesives: 250 g/L.
    - h. Single-Ply Roof Membrane Sealants: 450 g/L.
    - i. Nonmembrane Roof Sealants: 300 g/L.
    - j. Sealant Primers for Nonporous Substrates: 250 g/L.
    - k. Sealant Primers for Porous Substrates: 775 g/L.
  - 3. Insulation Fasteners: Insulation manufacturer's standard factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover board to substrate, and acceptable to roofing system manufacturer.

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2.7 COVER BOARD

- A. General: Cover board as recommended in writing by roofing membrane manufacturer for intended use and compatible with other roofing system components.
- B. High-Density Polyisocyanurate Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1/2 inch thick, with a minimum compressive strength of 80 psi.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ISOGARD HD, or comparable product.

2.8 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.
  - 1. Size: Approximately 36 by 60 inches.
  - 2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Roofing System Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
  - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation in accordance with roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Perform fastener-pullout tests in accordance with roofing system manufacturer's written instructions.
  - 1. Submit test result within 24 hours of performing tests.



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- a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING SYSTEM, GENERAL

- A. Install roofing system materials and components in accordance with roofing system manufacturer's written installation instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Coordinate installation and transition of roofing system component serving as an air barrier with wall system air barrier specified under Section 072713 "Modified Bituminous Sheet Air Barriers" and Section 072726 "Fluid-Applied Membrane Air Barriers."
- D. Substrate-Joint Penetrations: Prevent adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 INSTALLATION OF VAPOR RETARDER

- A. Install vapor retarder in a single layer over roof area in accordance with manufacturer's written installation instructions, side and end lapping each sheet a minimum of 2 and 6 inches, respectively.
  - 1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
  - 2. Continuously seal side and end laps with tape.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.5 INSTALLATION OF ROOF INSULATION AND ACCESSORIES

- A. Coordinate installation of roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written installation instructions. Install minimum of two layers of insulation under area of roofing to achieve required thickness.
- C. Install each layer of insulation with joints staggered not less than 24 inches in adjacent rows and offset not less than 12 inches from previous layer.
  - 1. Trim insulation neatly to fit around penetrations and projections, and to fit tightly to intersecting sloping roof decks.
  - 2. Make joints between adjacent insulation boards not more than 1/4 inch in width.

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3. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches.
4. Trim insulation, so that water flow is unrestricted.
5. Fill gaps exceeding 1/4 inch with insulation.
6. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
7. Secure insulation in accordance with FM Approvals' RoofNav for specified Windstorm Resistance Classification.
8. Secure insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

### 3.6 INSTALLATION OF COVER BOARD

- A. Install cover board over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
  1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  2. At internal roof drains, conform to slope of drain sump.
    - a. Trim cover board so that water flow is unrestricted.
  3. Cut and fit cover board tight to nailers, projections, and penetrations.
  4. Adhere cover board to substrate in accordance with FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29.

### 3.7 INSTALLATION OF EPDM ROOFING MEMBRANE

- A. Install roofing membrane over roof area for adhered or self-adhered application method in accordance with roofing system manufacturer's written installation instructions.
- B. Unroll roofing membrane and allow it to relax before installing.
- C. Start installation in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- E. Adhered Application: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply to splice area of roofing membrane.
  1. In addition to adhering, mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roof area.
- F. Tape Seam Installation: Clean and prime both faces of splice areas and apply splice tape.
  1. Firmly roll side and end laps of overlapping roofing membrane to ensure a watertight seam installation.

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2. Apply lap sealant and seal exposed edges of roofing terminations.
- G. Repair tears, voids, and lapped seams in roofing membrane that do not comply with requirements.
- H. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roofing membrane in place with clamping ring.
- I. Adhere protection sheet over roofing membrane at locations indicated.

3.8 INSTALLATION OF BASE AND SHEET FLASHINGS

- A. General: Install and adhere base and sheet flashings and preformed flashing accessories to substrates in accordance with roofing system manufacturer's written installation instructions.
- B. Apply bonding adhesive to substrate and underside of flashings at required rate and allow to partially dry. Do not apply to seam area of flashings.
- C. Flash penetrations and field-formed inside and outside corners.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping flashings to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of terminations.
- E. Terminate and seal top of flashings and mechanically anchor to substrate through termination bars.

3.9 INSTALLATION OF WALKWAYS

- A. Flexible Walkways: Install walkway products in accordance with manufacturer's written installation instructions.
  1. Install flexible walkways at the following locations:
    - a. Perimeter of each rooftop unit.
    - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    - c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    - d. Top and bottom of each roof access ladder.
    - e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
    - f. Locations indicated on Drawings.
    - g. As required by roofing membrane manufacturer's warranty requirements.
  2. Provide 6-inch clearance between adjoining pads.
  3. Adhere walkway products to substrate with compatible adhesive in accordance with roofing system manufacturer's written instructions.

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3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, and installation of roofing membrane, flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Perform the following tests:
  - 1. ELD Testing: Testing agency surveys entire roof area and flashings to locate discontinuities in the roofing membrane using ELD in accordance with ASTM D7877 and ASTM D8231.
    - a. After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.
      - 1) Cost of retesting is Contractor's responsibility.
    - b. Testing agency to prepare survey report indicating locations of initial discontinuities, if any.
  - 2. Flood Testing: Flood test each roof area for leaks, in accordance with recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
    - a. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches of clearance from top of base flashing.
    - b. Flood each area for 48 hours.
    - c. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
      - 1) Cost of retesting is Contractor's responsibility.
    - d. Testing agency to prepare survey report indicating locations initial leaks, if any, and final survey report.
  - 3. Infrared Thermography Testing: Testing agency surveys entire roof area using infrared color thermography in accordance with ASTM C1153. Perform tests before overlying construction is placed.
    - a. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing or nuclear hydrogen detection testing.
    - b. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
      - 1) Cost of retesting is Contractor's responsibility.
    - c. Testing agency to prepare survey report of initial scan indicating locations of entrapped moisture, if any.
  - 4. Electrical Capacitance/Impedance Testing: Testing agency surveys entire roof area for entrapped water within roof assembly in accordance with ASTM D7954/D7954M.

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Perform tests before overlying construction is placed.

- a. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
    - 1) Cost of retesting is Contractor's responsibility.
  - b. Testing agency to prepare survey report indicating locations of entrapped moisture, if any.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.12 ROOFING SYSTEM INSTALLER'S WARRANTY

- A. WHEREAS \_\_\_\_\_ of \_\_\_\_\_, herein called the "Roofing System Installer," has performed roofing and associated Work on the following Project:
1. Owner: **<Insert name of Owner>**.
  2. Owner Address: **<Insert address>**.
  3. Building Name/Type: **<Insert information>**.
  4. Building Address: **<Insert address>**.
  5. Area of Work: **<Insert information>**.
  6. Acceptance Date: \_\_\_\_\_.
  7. Warranty Period: [**Two**][**Five**]**<Insert number>** years from date of Substantial Completion.
  8. Date of Substantial Completion: \_\_\_\_\_.

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- B. AND WHEREAS Roofing System Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said Work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing System Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing System Installer's own cost and expense, make or cause to be made such repairs to or replacements of said Work as are necessary to correct faulty and defective work and as are necessary to maintain said Work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to Work and other parts of the building, and to building contents, caused by:
    - a. lightning;
    - b. peak gust wind speed exceeding <Insert mph>;
    - c. fire;
    - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the Work;
    - f. vapor condensation on bottom of roofing; and
    - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
  2. When Work has been damaged by any of foregoing causes, Warranty will be null and void until such damage has been repaired by Roofing System Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  3. Roofing System Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of Work.
  4. During Warranty Period, if Owner allows alteration of Work by anyone other than Roofing System Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty will become null and void on date of said alterations, but only to the extent said alterations affect Work covered by this Warranty. If Owner engages Roofing System Installer to perform said alterations, Warranty will not become null and void unless Roofing System Installer, before starting said Work, will have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate Work, thereby reasonably justifying a limitation or termination of this Warranty.
  5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty will become null and void on date of said change, but only to the extent said change affects Work covered by this Warranty.
  6. Owner will promptly notify Roofing System Installer of observed, known, or suspected leaks, defects, or deterioration and will afford reasonable opportunity for Roofing System Installer to inspect Work and to examine evidence of such leaks, defects, or deterioration.

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7. This Warranty is recognized to be the only warranty of Roofing System Installer on said Work and will not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty will not operate to relieve Roofing System Installer of responsibility for performance of original Work in accordance with requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

1. Authorized Signature: \_\_\_\_\_.
2. Name: \_\_\_\_\_.
3. Title: \_\_\_\_\_.

END OF SECTION

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Formed low-slope roof sheet metal fabrications.

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
  - 2. Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" and 077100 "Roof Specialties" for materials and installation of sheet metal flashing and trim integral with roofing.
  - 3. Section 074213.13 "Formed Metal Wall Panels" for sheet metal flashing and trim integral with metal wall panels.
  - 4. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.



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C. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of special conditions.
10. Include details of connections to adjoining work.

D. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

E. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For fabricator.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

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1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

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1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
  1. Surface: Smooth, flat.
  2. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - b. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
  3. Color: As selected by Architect from manufacturer's full range.
  4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

## 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
    - a. Carlisle Residential; a division of Carlisle Construction Materials; WIP 300HT.
    - b. GCP Applied Technologies Inc. (formerly Grace Construction Products); Grace Ice and Water Shield HT.
    - c. Henry Company; Blueskin PE200 HT.
    - d. Owens Corning; WeatherLock Metal High Temperature Underlayment.
  2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
  3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

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- C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

## 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
  - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  - 2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## 2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  - 2. Obtain field measurements for accurate fit before shop fabrication.

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3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
  2. Use lapped expansion joints only where indicated on Drawings.
- E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- I. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-to-Wall Transition Expansion-Joint Cover: Fabricate from the following materials: Shop fabricate interior and exterior corners.
1. Aluminum-Zinc Alloy-Coated Steel: 0.034 inch thick.
- B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

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- D. Flashing Receivers: Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- E. Roof-Penetration Flashing: Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.
- C. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

#### 3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

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1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
  5. Torch cutting of sheet metal flashing and trim is not permitted.
  6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
  2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
  2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Rivets: Rivet joints where necessary for strength.

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3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Materials and installation are specified in Section 077100 "Roof Specialties."
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Material and installation of through-wall flashing is specified in Section 042000 "Unit Masonry."
- C. Reglets: Material and installation of reglets is specified in Section 077100 "Roof Specialties."

3.6 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.7 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.



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- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Roof-edge specialties.
- 2. Reglets and counterflashing.

B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
- 2. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
- 3. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
- 4. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For roof specialties.

- 1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
- 2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
- 3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
- 4. Detail termination points and assemblies, including fixed points.
- 5. Include details of special conditions.

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- D. Samples: For each type of roof specialty and for each color and texture specified.
- E. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.
- F. Samples for Verification:
  - 1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
  - 2. Include roof-edge specialties made from 12-inch lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For manufacturer.
- C. Product Certificates: For each type of roof specialty.
- D. Product Test Reports: For roof-edge flashings, for tests performed by a qualified testing agency.
- E. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.
- B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing."
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof edge as shown on Drawings.
  - 2. Build mockup of typical roof edge as part of Integrated Exterior Mockup specified in Section 014000 "Quality Requirements"
  - 3. Build mockup of typical roof edge, including fascia, approximately 10 feet long, including supporting construction, seams, attachments, underlayment, and accessories.

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4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing."
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

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- B. FM Approvals' Listing: Manufacture and install roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.
- C. SPRI Wind Design Standard: Manufacture and install roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:
  - 1. Design Wind Load: As indicated on Drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 ROOF-EDGE SPECIALTIES

- A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 10 feet and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching corner units.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "TerminEdge EX" OMG Roofing Products, or comparable product by one of the following:
    - a. Metal-Era, Inc.
    - b. Metal-Fab Manufacturing LLC.
    - c. Perimeter Systems; a division of SAF.
  - 2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, thickness as required to meet performance requirements.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Two-coat fluoropolymer.
    - c. Color: As selected by Architect from manufacturer's full range.
  - 3. Corners: Factory mitered and mechanically clinched and sealed watertight.
  - 4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
  - 5. Receiver: Manufacturer's standard material and thickness.
  - 6. Special Fabrications: Bullnose fascia cover.
  - 7. Fascia Accessories: Fascia extenders with continuous hold-down cleats.

## 2.3 REGLETS AND COUNTERFLASHINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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1. [Berridge Manufacturing Company.](#)
2. [Castle Metal Products.](#)
3. [Cheney Flashing Company.](#)
4. [Drexel Metals.](#)
5. [Fry Reglet Corporation.](#)
6. [Heckmann Building Products, Inc.](#)
7. [Hickman Company, W. P.](#)
8. [Keystone Flashing Company, Inc.](#)
9. [Metal-Era, Inc.](#)

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Zinc-Coated Steel: Nominal 0.022-inch thickness.
2. Corners: Factory mitered and mechanically clinched and sealed watertight.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Multiuse Type, Embedded: For multiuse embedment in cast-in-place concrete or masonry mortar joints.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal:

1. Zinc-Coated Steel: Nominal 0.022-inch thickness.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Zinc-Coated Steel Finish: Two-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

## 2.4 MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
- C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

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2.5 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carlisle Coatings & Waterproofing Inc; CCW WIP 300HT.
    - b. GCP Applied Technologies Inc. (formerly Grace Construction Products); Grace Ice and Water Shield HT.
    - c. Henry Company; Blueskin PE200 HT.
    - d. Owens Corning; WeatherLock Metal High Temperature Underlayment.
  - 2. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F.
  - 3. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F.
- B. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

2.6 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
  - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
  - 2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
  - 3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
- B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Coil-Coated Galvanized-Steel Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- E. Coil-Coated Aluminum Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- F. Aluminum Extrusion Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.



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- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
  - 1. Apply continuously under roof-edge specialties and reglets and counterflashings.
  - 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.
- B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

### 3.3 INSTALLATION, GENERAL

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
  - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  - 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  - 4. Torch cutting of roof specialties is not permitted.
  - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

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- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
  - 1. Space movement joints at a maximum of 10 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
  - 2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Seal concealed joints with sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

### 3.4 ROOF-EDGE SPECIALITIES INSTALLATION

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

### 3.5 REGLET AND COUNTERFLASHING INSTALLATION

- A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.
- B. Embedded Reglets: Embed reglets as recommended by manufacturer and as indicated on Drawings.
- C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.
- D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

### 3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal

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filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Roof curbs.
- 2. Equipment supports.
- 3. Roof hatches.

B. Related Sections:

- 1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
- 2. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
- 3. Section 077100 "Roof Specialties" for manufactured fasciae and counterflashing.
- 4. Section 230548 "Vibration and Seismic Controls for HVAC" for special curbs designed to accommodate seismic and vibration controls.
- 5. Section 233423 "HVAC Power Ventilators" for power roof-mounted ventilators.
- 6. Section 237413 "Packaged, Outdoor, Central-Station Air-Handling Units" for standard curbs specified with rooftop units.
- 7. Section 283111 "Digital, Addressable Fire-Alarm System" for interconnects to automatically operated heat and smoke vents.

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Product Data: For each type of roof accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: For roof accessories.
  - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- D. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.
- E. Delegated-Design Submittal: For roof curbs and equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
  - 2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
  - 1. Size and location of roof accessories specified in this Section.
  - 2. Method of attaching roof accessories to roof or building structure.
  - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
  - 4. Required clearances.
- C. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

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1.7 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Wind-Restraint Performance: As indicated on Drawings.

2.2 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AES Industries, Inc.
    - b. Air Balance; a division of MESTEK, Inc.
    - c. Custom Solution Roof and Metal Products.
    - d. Greenheck Fan Corporation.
    - e. KCC International Inc.
    - f. Lloyd Industries, Inc.
    - g. LMCurbs.
    - h. Louvers & Dampers, Inc.; a division of Mestek, Inc.

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- i. [Metallic Products Corp.](#)
  - j. [Milcor; Commercial Products Group of Hart & Cooley, Inc.](#)
  - k. [Pate Company \(The\).](#)
  - l. [Roof Curb Systems.](#)
  - m. [Roof Products and Systems \(RPS\); a division of Hart & Cooley, Inc.](#)
  - n. [Roof Products, Inc.](#)
  - o. [Thybar Corporation.](#)
  - p. [Vent Products Co., Inc.](#)
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet, 0.064 inch thick.
- 1. Finish: Baked enamel or powder coat.
  - 2. Color: As selected by Architect from manufacturer's full range.
- D. Construction:
- 1. Curb Profile: Manufacturer's standard compatible with roofing system.
  - 2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
  - 3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
  - 4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
  - 5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
  - 6. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
  - 7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
  - 8. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
  - 9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
  - 10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
  - 11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

## 2.3 EQUIPMENT SUPPORTS

- A. Equipment Supports: Premanufactured 11-gauge steel tubing adjustable frame with square steel 7-gauge feet for supporting mechanical equipment.
- 1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide “VRF/VRX-Super Stands”; Quick-Sling LLC, or a comparable product.

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- B. Size: Coordinate support stand capacity and size with mechanical equipment indicated on Drawings.
- C. Configuration: Provide manufacturer's recommended configuration required to support the number and layout of mechanical equipment indicated on Drawings.
- D. Fasteners: Provide manufacturers' standard zinc-coated galvanized fasteners.
- E. Finish: Baked enamel or powder coat.
  - 1. Color: As selected by Architect from manufacturer's full range.

2.4 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.
  - 1. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
  - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 coated.
  - 1. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
  - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- C. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.
- D. Steel Tube: ASTM A 500/A 500M, round tube.
- E. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.
- F. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.5 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.



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- C. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.
- D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWWA C2; not less than 1-1/2 inches thick.
- E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- F. Underlayment:
  - 1. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
  - 2. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
  - 3. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 4. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
  - 5. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
- G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- H. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- I. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
  - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
  - 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- E. Roof-Hatch Installation:
  - 1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
  - 2. Attach safety railing system to roof-hatch curb.
  - 3. Attach ladder-assist post according to manufacturer's written instructions.
- F. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

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3.3 REPAIR AND CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.
- B. Clean off excess sealants.
- C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

## SECTION 078413 - PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.
  - 3. Penetrations in smoke barriers.
  - 4. Penetrations in smoke partitions.

- B. Related Requirements:

- 1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, and in smoke barriers and smoke partitions.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site. Minimally, the Contractor, the firestopping testing agency, and the firestopping installer shall attend this meeting.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Product Schedule: For each penetration firestopping and/or smoke sealing system. Include location, illustration of system, and design designation of qualified testing and inspecting agency (such as UL W-L-1049).
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping and/or smoke sealing system, submit illustration, with modifications marked, approved by penetration system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated and/or smoke sealing system. Obtain approval of authorities having jurisdiction prior to submittal.

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2. Where sleeve lengths do not match the qualified testing and inspection agency's listed firestopping and/or smoke sealing assembly (often flush with wall/floor penetrated), submit illustration, with modifications marked, approved by penetration system manufacturer's fire protection engineer as an engineering judgment or equivalent fire-resistance-rated and/or smoke sealing system.
3. Provide product data and product schedule for penetration system designations to be used in a single submittal.

D. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.

E. Tests and inspections report by qualified testing agency.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: Documentation of training and experience for Installer and Inspector.
- C. Product Test Reports: For each penetration firestopping and/or smoke sealing system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- D. Inspection Reports: Include with the inspection report a summary table identifying the quantity and percentage of penetrations and voids of each system inspected, indicating compliance with ASTM E2393 and ASTM E2174. Submit inspection report stating that firestopping and smoke sealing work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.
- E. As-built update of product schedule.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:

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1. A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements"; or
  2. Firestopping subcontractor/installer shall be in the business of installing firestopping and related work only. Firestopping Contractor shall be certified/licensed by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years' experience in the installation of manufacturer's products in accordance with specified requirements. Submit documentation of this experience.
- B. The firestopping shall not be installed by any other subcontractors such as the electrical contractor, mechanical contractor, etc. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer and submit written certification of training and retain proof of certification for duration of firestop installation.
- C. One firestopping subcontractor/installer shall perform all firestopping and/or smoke sealing throughout the project.
- D. Obtain penetration firestopping systems, for each type of penetration and construction condition, from a single manufacturer.
- E. Inspector Qualifications: The inspector shall be acceptable to the Authority Having Jurisdiction and shall meet the criteria contained in ASTM E699 for agencies involved in quality assurance and shall have a minimum of ten years experience in construction field inspections of firestopping systems, products, and assemblies. The inspector shall be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected. The inspector shall not be a competitor of the installer, the contractor, the manufacturer, or supplier of any material or item being inspected.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration systems when ambient or substrate temperatures are outside limits permitted by penetration systems manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping and/or smoke sealing materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping and/or smoke sealing systems can be installed according to specified system design.
- B. Coordinate material, length and sizing of sleeves, openings, core-drilled holes, cut openings, and annular space to accommodate penetration firestopping and/or smoke sealing systems.

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- C. Coordinate material, diameter and length of sleeves, if used, with other trades and with firestopping and/or smoke sealing assemblies selected.
- D. Notify Contractor's testing agency at least seven days in advance of penetration system installations; confirm dates and times on day preceding each series of installations.
- E. Coordinate insulation types and thicknesses for pipes and ductwork with the mechanical trade. Provide firestopping and/or smoke sealing systems that have been tested for the type and thickness of insulation to be utilized. Where a listed system is not available for the type or thickness of insulation to be utilized, notify the mechanical trade and the Owner. Do not cut or remove thermal insulation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
  - 1. Perform penetration firestopping and/or smoke sealing system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Penetration Firestopping and/or Smoke Sealing Systems" Article. Provide rated systems complying with the following requirements:
    - a. Penetration firestopping and/or smoke sealing systems shall bear classification marking of a qualified testing agency.
      - 1) UL in its online directory "Product iQ."
      - 2) Intertek Group in its "Directory of Building Products."
      - 3) FM Approvals in its "Approval Guide."

### 2.2 PENETRATION FIRESTOPPING AND/OR SMOKE SEALING SYSTEMS

- A. Penetration Firestopping and/or Smoke Sealing Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations include both through-penetrations where the entire assembly is penetrated, and membrane-penetrations where only a portion of the assembly is penetrated.
- C. Penetrations include, but are not limited to, the annular space around pipes, tubes, ductwork without a fire damper, conduit, wires, cables, vents, and structural members.
  - 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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- a. 3M Fire Protection Products.
  - b. A/D Fire Protection Systems Inc.
  - c. Grabber Construction Products.
  - d. Hilti, Inc.
  - e. HOLDRITE.
  - f. Passive Fire Protection Partners.
  - g. RectorSeal.
  - h. Specified Technologies, Inc.
  - i. Tremco, Inc.
- D. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- E. Penetrations in Horizontal Fire-Resistance Rated Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  3. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- F. Penetrations in Smoke Barriers and Smoke Partitions: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- G. Exposed Penetration Firestopping and Smoke Sealing Systems: Flame-spread and smoke-developed indexes of less than 25 and 50, respectively, per ASTM E 84.
1. Sealant shall have a VOC content of 250 g/L or less.
  2. Verify sealant complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- H. Accessories: Provide components for each penetration system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
1. Permanent forming/damming/backing materials.
  2. Substrate primers.



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3. Collars.
  4. Steel sleeves.
  5. Wire mesh.
  6. Metal lath.
- 
- I. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
  - J. Provide sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.
  - K. Openings within walls and floors designed to accommodate voice, data, and video cabling shall be provided with pre-manufactured modular devices, containing built-in self-sealing intumescent inserts, that allow for cable moves, additions, or changes without the need to remove or replace firestop and/or smoke sealing materials. Devices must be capable of maintaining the fire and/or smoke resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill; while maintaining "L" rating of <5 cfm/sf (measured at ambient temperature and 400 degrees F) at 0 percent to 100 percent visual fill.
  - L. For piping penetrations for plumbing, wet-pipe sprinkler systems, and similar piping subject to moisture, provide moisture resistant penetration firestopping and/or smoke sealing systems.
  - M. Penetration systems for floor voids 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support.
  - N. Finish: Where firestopping and/or smoke sealing will remain exposed in finished locations, provide paintable products.

## 2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

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- G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

## 2.4 MIXING

- A. Penetration Firestopping and/or Smoke Sealing Materials: For those products requiring mixing before application, comply with penetration system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Verify that penetrating items are rigidly supported on both sides of the assembly penetrated unless otherwise permitted by the listed firestopping and/or smoke sealing system.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping and/or smoke sealing systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping and/or smoke sealing material such as drywall tape and joint compound, dirt, grease, oil, or scale.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping and/or smoke sealing materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.

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- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### 3.3 INSTALLATION

- A. General: Install penetration firestopping and/or smoke sealing systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire and/or smoke ratings.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of the penetration system.
- C. Install fill materials by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- D. Fire dampers are not to be provided with penetration firestopping or smoke sealing unless the use of firestopping or smoke sealant has been tested and approved as part of the fire damper system.

### 3.4 IDENTIFICATION

- A. Wall Identification: Permanently label fire and/or smoke resistant rated walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes. Apply signs using red or contrasting paint over stencils. Prevent overspray onto adjacent surfaces. If overspray does occur, clean-up or replacement of damaged surfaces is the responsibility of the Contractor.
  - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 5 feet from end of wall and at intervals not exceeding 10 feet. Do not provide labels in finished areas such as sleeping rooms, offices, classrooms, lobbies, corridors, stairs, etc.
- B. Penetration Identification: Identify each penetration firestopping and/or smoke sealing system with legible manufacturer's pre-printed labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration system edge so labels are visible to anyone seeking to remove penetrating items or firestopping and/or smoke sealing systems. Do not provide labels in finished areas such as sleeping rooms, offices, classrooms, lobbies, corridors, stairs, etc. Use

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mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Ensure that surface is clean prior to application. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Contractor must engage a qualified testing agency to perform tests and inspections according to ASTM E 2174 and prepare report(s) of findings.
  1. Test and inspect as required by the 2015 International Building Code (IBC), Subsection 1705.17, "Fire-Resistant Penetrations and Joints".
- B. Testing shall include destructive testing to assure proper installation/application.
- C. Where deficiencies are found or penetration system is damaged or removed because of testing, repair or replace penetration system to comply with requirements.
- D. Proceed with enclosing penetration systems with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping and/or smoke sealing systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and/or smoke sealing material and install new materials to produce systems complying with specified requirements.

END OF SECTION

## SECTION 078443 - JOINT FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Joints in or between fire-resistance-rated constructions.
  - 2. Joints in smoke barriers and smoke partitions.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, smoke barriers, and smoke partitions and for wall identification.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site. Minimally, the Contractor, the firestopping testing agency, and the firestopping installer shall attend this meeting.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

- B. Product Data: For each type of product.

- C. Product Schedule: For each joint firestopping and/or smoke sealing system. Include location, illustration of firestopping and/or smoke sealing system, and design designation of qualified testing agency (such as UL HW-D-0296).

- 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping and/or smoke sealing system condition, submit illustration, with modifications marked, approved by joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated or smoke-resistant rated system.
  - 2. Provide firestopping system designations to be used in a single submittal.

- D. Sustainable Design Submittals:

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1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

E. Tests and inspections report by qualified testing agency.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: Documentation of training and experience for Installer and Inspector.
- C. Product Test Reports: For each joint firestopping and/or smoke sealing system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Installer Certificates: From Installer indicating that joint firestopping and/or smoke sealing systems have been installed in compliance with requirements and manufacturer's written instructions.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- D. Inspection Reports: Include with the inspection report a summary table identifying the lineal feet of each system inspected, indicating compliance with ASTM E2393 and ASTM E2174. Submit inspection report stating that firestopping and smoke sealing work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.
- E. As-built update of product schedule.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  1. A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements"; or
  2. Firestopping subcontractor/installer shall be in the business of installing firestopping and related work only. Firestopping Contractor shall be certified/licensed by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years'

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experience in the installation of manufacturer's products in accordance with specified requirements. Submit documentation of this experience.

- B. The firestopping and/or smoke sealing shall not be installed by any other subcontractors such as the electrical contractor, mechanical contractor, etc. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer and submit written certification of training and retain proof of certification for duration of firestop installation.
- C. One firestopping subcontractor/installer shall perform all firestopping throughout the project.
- D. Obtain joint firestopping and/or smoke sealing systems, for each type of penetration and construction condition, from a single manufacturer.
- E. Inspector Qualifications: The inspector shall be acceptable to the Authority Having Jurisdiction and shall meet the criteria contained in ASTM E699 for agencies involved in quality assurance and shall have a minimum of ten years experience in construction field inspections of firestopping systems, products, and assemblies. The inspector shall be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected. The inspector shall not be a competitor of the installer, the contractor, the manufacturer, or supplier of any material or item being inspected.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint systems when ambient or substrate temperatures are outside limits permitted by joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping and/or smoke sealing systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

## 1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping and/or smoke sealing systems can be installed according to specified system design.
- B. Coordinate sizing of joints to accommodate joint firestopping and/or smoke sealing systems.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:

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1. Perform joint firestopping and/or smoke sealing system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping and/or Smoke Sealing Systems" Article. Provide rated systems complying with the following requirements:
  - a. Joint firestopping and/or smoke sealing systems shall bear classification marking of a qualified testing agency.
    - 1) UL in its online directory "Product iQ."
    - 2) Intertek Group in its "Directory of Building Products."

2.2 JOINT FIRESTOPPING AND/OR SMOKE SEALING SYSTEMS

- A. Joint Firestopping and/or Smoke Sealing Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating and smoke-resistance rating of assemblies in or between which joint firestopping and/or smoke sealing systems are installed. Joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, ponding water or other forms of moisture characteristic during and after construction.
- C. Systems for floor voids 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support.
- D. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. 3M Fire Protection Products.
    - b. A/D Fire Protection Systems Inc.
    - c. BlazeFrame Industries.
    - d. Grabber Construction Products.
    - e. Hilti, Inc.
    - f. Nelson Firestop; a brand of Emerson Industrial Automation.
    - g. Passive Fire Protection Partners.
    - h. RectorSeal.
    - i. ROXUL.
    - j. Specified Technologies, Inc.
    - k. Thermafiber, Inc.; an Owens Corning company.
    - l. Tremco, Inc.
  2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed. Where joints are between assemblies of



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two different fire resistance ratings, the joint shall have an hourly rating meeting or exceeding the highest fire resistance rating of the two assemblies.

3. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- E. Joints in or between Smoke Barriers: Provide fire-resistive and smoke-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. 3M Fire Protection Products.
    - b. A/D Fire Protection Systems Inc.
    - c. Hilti, Inc.
    - d. Nelson Firestop; a brand of Emerson Industrial Automation.
    - e. Passive Fire Protection Partners.
    - f. RectorSeal.
    - g. ROXUL.
    - h. Specified Technologies, Inc.
    - i. Thermafiber, Inc.; an Owens Corning company.
    - j. Tremco, Inc.
  2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed. Where joints are between assemblies of two different fire resistance ratings, the joint shall have an hourly rating meeting or exceeding the highest fire resistance rating of the two assemblies.
  3. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- F. Joints in Smoke Partitions: Provide smoke-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. 3M Fire Protection Products.
    - b. A/D Fire Protection Systems Inc.
    - c. Hilti, Inc.
    - d. Nelson Firestop; a brand of Emerson Industrial Automation.
    - e. Passive Fire Protection Partners.
    - f. RectorSeal.
    - g. ROXUL.
    - h. Specified Technologies, Inc.
    - i. Thermafiber, Inc.; an Owens Corning company.
    - j. Tremco, Inc.
  2. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.

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- G. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.
  - 1. Sealant shall have a VOC content of 250 g/L or less.
  - 2. Verify sealant complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- H. Accessories: Provide components of joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint system manufacturer and approved by the qualified testing agency for conditions indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive and/or smoke sealing joint systems, clean joints immediately to comply with joint system manufacturer's written instructions and the following requirements:
  - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating such as drywall tape and joint compound, dirt, grease, oil, or scale.
  - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

#### 3.3 INSTALLATION

- A. General: Install fire-resistive and/or smoke sealing joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

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- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire and/or smoke ratings indicated.
  - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of joint system.
- C. Install elastomeric fill materials for joint systems by proven techniques to produce the following results:
  - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve ratings indicated.
  - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
  - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with manufacturer's pre-printed legible labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping and/or smoke sealing system. Do not provide labels in finished areas such as sleeping rooms, offices, classrooms, lobbies, corridors, stairs, etc. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Ensure that surface is clean prior to application. Include the following information on labels:
  - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing agency.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Contractor must engage a qualified testing agency to perform tests and inspections according to ASTM E 2393 and prepare reports(s) of findings.
  - 1. Test and inspect as required by the 2015 International Building Code (IBC), Subsection 1705.17, "Fire-resistant penetrations and joints".
- B. Testing shall include destructive testing to assure proper installation/application.
- C. Where deficiencies are found or joint systems are damaged or removed due to testing, repair or replace joint systems so they comply with requirements.

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- D. Proceed with enclosing joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping and/or smoke sealing systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint and/or smoke sealing systems immediately and install new materials to produce fire-resistive and/or smoke sealing joint systems complying with specified requirements.

END OF SECTION

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SECTION 079100 - PREFORMED JOINT SEALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preformed, foam joint seals.
2. Extruded-silicone joint seals.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for liquid sealants applied over preformed seals in dual-seal systems.

1.2 ACTION SUBMITTALS

A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Product Data:

1. Preformed, foam joint seals.
2. Extruded-silicone joint seals.

C. Samples for Initial Selection: Manufacturer's color sheets, showing full range of available colors for each type of exposed preformed joint seal.

D. Samples for Verification: Actual samples of each type and color of exposed preformed joint seal.

1. Size: 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint seals.

E. Preformed Joint Seal Schedule: Include the following information:

1. Joint seal location and designation.
2. Joint width and movement capability.
3. Joint seal manufacturer and product name.
4. Joint seal color.

1.3 INFORMATIONAL SUBMITTALS

A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

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B. Test and Evaluation Reports:

1. Product Test Reports: For each preformed joint seal, for tests performed by qualified testing agency.

C. Sample warranties.

1.4 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace preformed joint seals that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish preformed joint seals to repair or replace those that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. For preformed joint seals, obtain each color, type, and variety of joint seal from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PREFORMED, FOAM JOINT SEALS

- A. Preformed, Foam Joint Seals : Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce them in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. EMSEAL; a Sika Company
- b. LymTal International, Inc.
- c. MM Systems Corporation
- d. Nystrom, Inc.
- e. Pecora Corporation
- f. Schul International Company, LLC
- g. Watson Bowman Acme Corp.
- h. Willseal LLC, part of Tremco CPG

2. Design Criteria:

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- a. Nominal Joint Width: As indicated on Drawings.
  - b. Minimum Joint Width: As indicated on Drawings.
  - c. Maximum Joint Width: As indicated on Drawings.
3. Joint Seal Color: As selected by Architect from full range of industry colors.

2.3 EXTRUDED-SILICONE JOINT SEALS

- A. Extruded-Silicone Joint Seals : Manufacturer's standard seal consisting of precured low-modulus silicone extrusion, with a neutral-curing silicone sealant for bonding extrusions to substrates.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Nystrom, Inc.
    - c. Pecora Corporation
    - d. Sika Corporation
    - e. The Dow Chemical Company
    - f. Tremco Incorporated
  2. Joint Seal Width: Joint size indicated on Drawings plus 3/4 inch.
  3. Joint Seal Color: As selected by Architect from full range of industry colors.

2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by preformed joint seal manufacturer for joint substrates indicated.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces, and formulated to promote best adhesion to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with preformed joint seals and surfaces adjacent to joints.
- D. Sealant for Adhering Extruded-Silicone Joint Seals: Silicone adhesive sealant recommended by extruded-silicone joint seal manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive preformed joint seals, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting preformed joint seal performance.

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- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of preformed joint seal, including dust, paints (except for permanent protective coatings tested and approved for seal adhesion and compatibility by seal manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with preformed joint seals. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
    - d. Exterior insulation and finish systems.
  3. Remove laitance and form-release agents from concrete.
  4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint seals. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience. Apply primer to comply with joint seal manufacturer's written instructions. Confine primers to areas of joint seal bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF PREFORMED, FOAM JOINT SEALS

- A. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
1. Install each length of seal immediately after removing protective wrapping.
  2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.



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3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.

3.4 INSTALLATION OF EXTRUDED-SILICONE JOINT SEALS

- A. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
  1. Apply masking tape to each side of joint, outside of area to be covered by seal system.
  2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone seal system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
  3. Press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact with substrate.
  4. Complete installation of seal system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

3.5 PROTECTION

- A. Protect preformed joint seals from damage resulting from construction operations or other causes so seals are without deterioration or damage at time of Substantial Completion.
- B. Cut out, remove, and repair damaged or deteriorated seals so repaired areas are indistinguishable from original work.

END OF SECTION

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Nonstaining silicone joint sealants.
- 2. Mildew-resistant joint sealants.
- 3. Latex joint sealants.

B. Related Requirements:

- 1. Section 079100 "Preformed Joint Seals" for preformed compressible foam and precured joint seals.
- 2. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.
- 3. Section 321373 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each joint-sealant product.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- E. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.

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2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For qualified testing agency.
- C. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- D. Field-Adhesion-Test Reports: For each sealant application tested.
- E. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
  1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

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1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; Dow Corning® 795 Silicone Building Sealant.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.; Silpruf NB.
    - c. May National Associates, Inc.; a subsidiary of Sika Corporation; Bondaflex Sil 295 FPS NB.
    - d. Pecora Corporation; Pecora 895NST.

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- e. [Tremco Incorporated](#); Spectrem 3.

## 2.3 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
  - 1. [Products](#): Subject to compliance with requirements, provide one of the following:
    - a. [Dow Corning Corporation](#); DOW CORNING® 786 SILICONE SEALANT -.
    - b. [GE Construction Sealants; Momentive Performance Materials Inc.](#); SCS1700 Sanitary.
    - c. [May National Associates, Inc.; a subsidiary of Sika Corporation](#); Bondaflex Sil 100 WF.
    - d. [Soudal USA](#); RTV GP.
    - e. [Tremco Incorporated](#); Tremsil 200.

## 2.4 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. [Products](#): Subject to compliance with requirements, provide one of the following:
    - a. [BASF Construction Chemicals – Buildings Systems](#); Sonolac.
    - b. [May National Associates, Inc.; a subsidiary of Sika Corporation](#); Bondaflex Sil-A 700.
    - c. [Pecora Corporation](#); AC-20.
    - d. [Sherwin-Williams Company \(The\)](#); 950A Siliconized Acrylic Latex Caulk, White.
    - e. [Tremco Incorporated](#); Tremflex 834.

## 2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

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2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.

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- b. Glass.
  - c. Porcelain enamel.
  - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

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3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: The Owner will engage an independent testing agency to field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
  2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
  4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
  5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.



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3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
    - b. Control and expansion joints in unit masonry.
    - c. Joints between metal panels.
    - d. Joints between different materials listed above.
    - e. Perimeter joints between materials listed above and frames of doors windows and louvers.
    - f. Control and expansion joints in overhead surfaces.
    - g. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Vertical joints on exposed surfaces of unit masonry, walls, and partitions.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
  - 1. Joint Locations:
    - a. Control joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Acrylic latex or siliconized acrylic latex.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

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- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Concealed mastics.
  - 1. Joint Locations:
    - a. Aluminum thresholds.
    - b. Sill plates.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, non-staining S, NS, 50, NT.
- F. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

## SECTION 079219 - ACOUSTICAL JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes acoustical joint sealants.
- B. Related Requirements:
  - 1. Section 079200 "Joint Sealants" for elastomeric, and latex joint sealants for nonacoustical applications.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each acoustical joint sealant.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Acoustical-Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- C. Sample Warranties: For special warranties.

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1.5 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

2.2 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Accumetric LLC; Boxx 826 Acoustifal Sound Sealant.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.; RCS20 Acoustical.
    - c. Grabber Construction Products; Acoustical Sealant GSC.
    - d. OSI Sealants; Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
    - e. Pecora Corporation; AIS-919.
    - f. Serious Energy Inc.; Quiet Seal Pro.
    - g. Tremco Incorporated; Tremco Acoustical Sealant.
    - h. USG Corporation; SHEETROCK Acoustical Sealant.
  - 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

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- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

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3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 079513.13 - INTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor expansion joint covers.
2. Wall expansion joint covers.
3. Ceiling expansion joint covers.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
1. Floor expansion joint covers.
  2. Wall expansion joint covers.
  3. Ceiling expansion joint covers.
- C. Shop Drawings: For each expansion joint cover assembly.
1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
  2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- D. Samples: For each expansion joint cover assembly and for each color and texture specified, full width by 6 inches long in size.
- E. Samples for Initial Selection: For each type of exposed finish.
1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric-seal material.
- F. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches long in size.
- G. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
1. Manufacturer and model number for each expansion joint cover assembly.
  2. Expansion joint cover assembly location cross-referenced to Drawings.
  3. Nominal, minimum, and maximum joint width.

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4. Movement direction.
5. Materials, colors, and finishes.
6. Product options.
7. Fire-resistance ratings.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by a qualified testing agency.

1.4 MOCKUPS

- A. Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
  1. Build mockup of typical expansion joint cover assembly as shown on Drawings.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Expansion joint cover assemblies to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E1966 by a qualified testing agency.
  1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies to be subjected to hose stream testing.



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C. Expansion Joint Design Criteria :

1. Type of Movement: Thermal.
  - a. Nominal Joint Width: As indicated on Drawings.
  - b. Minimum Joint Width: As indicated on Drawings.
  - c. Maximum Joint Width: As indicated on Drawings.
2. Seismic Movement:
  - a. Joint Movement: As indicated on Drawings.

2.3 FLOOR EXPANSION JOINT COVERS

A. Metal-Plate Floor Joint Cover : Metal cover plate fixed on one side of joint gap and free to slide on other.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Architectural Art Manufacturing; a division of Pittcon Architectural Metals, LLC
  - b. Balco; a CSW Industrials Company
  - c. Construction Specialties, Inc.
  - d. Erie Metal Specialties, Inc.
  - e. inpro Corporation
  - f. MM Systems Corporation
  - g. Nystrom, Inc.
  - h. Watson Bowman Acme Corp.
2. Installation: Surface mounted.
3. Load Capacity:
  - a. Uniform Load: 50 lb/sq. ft.
  - b. Concentrated Load: 300 lb
  - c. Maximum Deflection: 0.0625 inch.
4. Fire-Resistance Rating: Not less than that indicated on Drawings.
5. Cover-Plate Design: Plain.
6. Exposed Metal:
  - a. Aluminum: Manufacturer's standard.
    - 1) Color: As selected by Architect from full range of industry colors and color densities.

B. Center-Plate Floor Joint Cover : Assembly consisting of center plate that slides over metal frames fixed to sides of joint gaps.

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Architectural Art Manufacturing; a division of Pittcon Architectural Metals, LLC
    - b. Balco; a CSW Industrials Company
    - c. Construction Specialties, Inc.
    - d. inpro Corporation
    - e. MM Systems Corporation
    - f. Nystrom, Inc.
    - g. Watson Bowman Acme Corp.
  2. Application: Floor to floor.
  3. Installation: Recessed.
  4. Load Capacity:
    - a. Uniform Load: 50 lb/sq. ft.
    - b. Concentrated Load: 300 lb.
    - c. Maximum Deflection: 0.0625 inch.
  5. Fire-Resistance Rating: Not less than that of adjacent construction.
  6. Cover-Plate Design: Plain.
  7. Exposed Metal:
    - a. Aluminum: Manufacturer's standard.
      - 1) Color: As selected by Architect from full range of industry colors and color densities.
- C. Glide-Plate Floor Joint Cover : Assembly consisting of center plate that slides in and out of slots in metal frames fixed to sides of joint gap.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Architectural Art Manufacturing; a division of Pittcon Architectural Metals, LLC
    - b. Balco; a CSW Industrials Company
    - c. Construction Specialties, Inc.
    - d. Erie Metal Specialties, Inc.
    - e. inpro Corporation
    - f. MM Systems Corporation
    - g. Nystrom, Inc.
    - h. Watson Bowman Acme Corp.
  2. Application: Floor to floor.
  3. Installation: Recessed.
  4. Load Capacity:
    - a. Uniform Load: 50 lb/sq. ft.
    - b. Concentrated Load: 300 lb.
    - c. Maximum Deflection: 0.0625 inch.

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5. Fire-Resistance Rating: Not less than that of adjacent construction.
6. Exposed Metal:
  - a. Aluminum: Manufacturer's standard.
    - 1) Color: As selected by Architect from full range of industry colors and color densities.

D. Hidden-Sightline Floor Joint Cover : Sliding leaf-spring and metal frame assembly designed to accept field-applied finish materials on visible surfaces for minimum frame exposure.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Balco; a CSW Industrials Company
  - b. Construction Specialties, Inc.
  - c. inpro Corporation
  - d. MM Systems Corporation
  - e. Nystrom, Inc.
  - f. Watson Bowman Acme Corp.
2. Application: Floor to floor and floor to wall.
3. Installation: Recessed.
4. Load Capacity:
  - a. Uniform Load: 50 lb/sq. ft.
  - b. Concentrated Load: 300 lb.
  - c. Maximum Deflection: 0.0625 inch.
5. Fire-Resistance Rating: Not less than that of adjacent construction.

2.4 CEILING EXPANSION JOINT COVERS

A. Metal-Plate Ceiling Joint Cover : Metal cover plate fixed on one side of joint gap and free to slide on other.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Architectural Art Manufacturing; a division of Pittcon Architectural Metals, LLC
  - b. Balco; a CSW Industrials Company
  - c. Construction Specialties, Inc.
  - d. inpro Corporation
  - e. MM Systems Corporation
  - f. Nystrom, Inc.
2. Application: Ceiling to ceiling and wall to ceiling.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Exposed Metal:

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- a. Aluminum: Manufacturer's standard.
  - 1) Color: As selected by Architect from full range of industry colors and color densities.
- B. Center-Plate Ceiling Joint Cover : Assembly consisting of center plate that slides over gasket in metal frames fixed to sides of joint gaps.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Architectural Art Manufacturing; a division of Pittcon Architectural Metals, LLC
    - b. Balco; a CSW Industrials Company
    - c. Construction Specialties, Inc.
    - d. inpro Corporation
    - e. Nystrom, Inc.
    - f. Watson Bowman Acme Corp.
  - 2. Application: Ceiling to ceiling.
  - 3. Fire-Resistance Rating: Not less than that of adjacent construction.
  - 4. Exposed Metal:
    - a. Aluminum: Manufacturer's standard.
      - 1) Color: As selected by Architect from full range of industry colors and color densities.
- C. Glide-Plate Ceiling Joint Cover : Assembly consisting of center plate that slides in and out of slots in metal frames fixed to sides of joint gap.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Architectural Art Manufacturing; a division of Pittcon Architectural Metals, LLC
    - b. Balco; a CSW Industrials Company
    - c. Construction Specialties, Inc.
    - d. inpro Corporation
    - e. MM Systems Corporation
    - f. Nystrom, Inc.
    - g. Watson Bowman Acme Corp.
  - 2. Application: Ceiling to ceiling.
  - 3. Fire-Resistance Rating: Not less than that of adjacent construction.
  - 4. Exposed Metal:
    - a. Aluminum: Manufacturer's standard.
      - 1) Color: As selected by Architect from full range of industry colors and color densities.

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- D. Elastomeric-Seal Ceiling Joint Cover : Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Architectural Art Manufacturing; a division of Pittcon Architectural Metals, LLC
    - b. Balco; a CSW Industrials Company
    - c. Construction Specialties, Inc.
    - d. Erie Metal Specialties, Inc.
    - e. inpro Corporation
    - f. MM Systems Corporation
    - g. Nystrom, Inc.
    - h. Watson Bowman Acme Corp.
  2. Application: Ceiling to ceiling and wall to ceiling.
  3. Fire-Resistance Rating: Not less than that of adjacent construction.
    - a. Aluminum: Manufacturer's standard.
      - 1) Color: As selected by Architect from full range of industry colors and color densities.
  4. Seal: Preformed elastomeric membranes or extrusions.
    - a. Color: As selected by Architect from manufacturer's full range.
- E. Elastomeric-Seal Acoustical Ceiling Joint Cover : Elastomeric-seal assembly designed for use in acoustical ceilings.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Architectural Art Manufacturing; a division of Pittcon Architectural Metals, LLC
    - b. Balco; a CSW Industrials Company
    - c. Construction Specialties, Inc.
    - d. Erie Metal Specialties, Inc.
    - e. inpro Corporation
    - f. Nystrom, Inc.
    - g. Watson Bowman Acme Corp.
  2. Application: Ceiling to ceiling and wall to ceiling.
  3. Fire-Resistance Rating: Not less than that of adjacent construction.
  4. Exposed Metal:
    - a. Aluminum: Manufacturer's standard.
      - 1) Color: As selected by Architect from full range of industry colors and color densities.

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5. Seal: Preformed elastomeric membranes or extrusions.
  - a. Color: As selected by Architect from manufacturer's full range.

## 2.5 MATERIALS

- A. Aluminum: ASTM B221, Alloy 6063-T5 for extrusions; ASTM B209, Alloy 6061-T6 for sheet and plate.
  1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.
- D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.
- E. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.6 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

## 2.7 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
  1. Provide where indicated on Drawings.
- B. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.

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- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

### 3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
  - 1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
  - 2. Install frames in continuous contact with adjacent surfaces.
    - a. Shimming is not permitted.
  - 3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
  - 4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
  - 5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
  - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
  - 1. Provide in continuous lengths for straight sections.
  - 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
  - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

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- E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
- F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
  - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- G. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION



## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Interior standard steel doors and frames.
  - 2. Exterior standard steel doors and frames.
  - 3. Borrowed lites.
- B. Related Requirements:
  - 1. Section 087111 "Door Hardware (Descriptive Specification)" for door hardware for hollow-metal doors.

#### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- C. Shop Drawings: Include the following:
  - 1. Elevations of each door and frame type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  - 7. Details of anchorages, joints, field splices, and connections.
  - 8. Details of accessories.
  - 9. Details of moldings, removable stops, and glazing.
- D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For door inspector.
  - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
  - 2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
  - 3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.
- C. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- D. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

1.8 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

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1.9 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
  - 2. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies is to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceco Door; ASSA ABLOY.
  - 2. Curries Company; ASSA ABLOY.
  - 3. Republic Doors and Frames.
  - 4. Steelcraft; an Allegion brand.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
  - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard

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construction requirements for tested and labeled fire-rated door assemblies except for size.

- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. when tested according to ASTM C 518.

## 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A..
  - 1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch.
    - d. Edge Construction: Model 1, Full Flush.
    - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    - f. Core: Manufacturer's standard Kraft-paper honeycomb.
    - g. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
  - 2. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
    - c. Construction: Face welded.
  - 3. Exposed Finish: Prime.

## 2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A..
  - 1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.

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- c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
  - d. Edge Construction: Model 1, Full Flush.
  - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
  - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
  - g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
  - h. Core: Polystyrene, Polyurethane, or Polyisocyanurate.
  - i. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
2. Frames:
- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
  - b. Construction: Knocked down and full profile welded. Provide welded type unless otherwise indicated.
3. Exposed Finish: Prime.

## 2.5 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.
- B. Construction: Face welded.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

## 2.6 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
  - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

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1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

## 2.7 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing" and 088813 "Fire Rated Glazing."

## 2.8 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
  2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

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- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
  - 1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
  - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
  - 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

## 2.9 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

- A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

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B. Hollow-Metal Frames: Comply with SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
  - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
  - b. Install frames with removable stops located on secure side of opening.
2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
  - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and 088813 "Fire Rated Glazing," and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.



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- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Access doors and frames.
2. Fire-rated access doors and frames.

B. Related Requirements:

1. Section 077200 "Roof Accessories" for roof hatches.
2. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
  1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.
- D. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For testing and inspecting agency.
  1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
  2. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

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1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Exposed Flanges:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acudor Products, Inc.
  - b. Babcock-Davis.
  - c. Cendrex Inc.
  - d. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - e. Karp Associates, Inc.
  - f. Larsens Manufacturing Company.
  - g. Metropolitan Door Industries Corp.
  - h. Milcor; Commercial Products Group of Hart & Cooley, Inc.
  - i. Nystrom, Inc.
- 2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
- 3. Locations: Wall.
- 4. Door Size: As indicated on Drawings.
- 5. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
- 6. Frame Material: Same material, thickness, and finish as door.
- 7. Latch and Lock: Cam latch, screwdriver operated.

- B. Flush Access Doors with Concealed Flanges:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acudor Products, Inc.
  - b. Babcock-Davis.
  - c. Cendrex Inc.
  - d. JL Industries, Inc.; a division of the Activar Construction Products Group.

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- e. [Karp Associates, Inc.](#)
  - f. [Larsens Manufacturing Company.](#)
  - g. [Metropolitan Door Industries Corp.](#)
  - h. [Milcor; Commercial Products Group of Hart & Cooley, Inc.](#)
  - i. [Nystrom, Inc.](#)
2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
  3. Locations: Wall and ceiling.
  4. Door Size: As indicated on Drawings.
  5. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
  6. Frame Material: Same material and thickness as door.
  7. Latch and Lock: Cam latch, screwdriver operated.
- C. Recessed Access Doors with Concealed Flanges:
1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
    - a. [Acudor Products, Inc.](#)
    - b. [Babcock-Davis.](#)
    - c. [Cendrex Inc.](#)
    - d. [JL Industries, Inc.; a division of the Activar Construction Products Group.](#)
    - e. [Karp Associates, Inc.](#)
    - f. [Larsens Manufacturing Company.](#)
    - g. [Metropolitan Door Industries Corp.](#)
    - h. [Milcor; Commercial Products Group of Hart & Cooley, Inc.](#)
    - i. [Nystrom, Inc.](#)
  2. Description: Door face recessed 1/2 inch or 5/8 inch for gypsum board infill to match adjacent surface; with concealed flange for gypsum board installation and concealed hinge.
  3. Locations: Wall and ceiling.
  4. Door Size: As indicated on Drawings.
  5. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
  6. Latch and Lock: Cam latch, screwdriver operated.

## 2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges:

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
  - a. [Acudor Products, Inc.](#)
  - b. [Babcock-Davis.](#)
  - c. [Cendrex Inc.](#)
  - d. [JL Industries, Inc.; a division of the Activar Construction Products Group.](#)
  - e. [Karp Associates, Inc.](#)
  - f. [Larsens Manufacturing Company.](#)
  - g. [Metropolitan Door Industries Corp.](#)
  - h. [Milcor; Commercial Products Group of Hart & Cooley, Inc.](#)

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- i. [Nystrom, Inc.](#)
  2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
  3. Locations: Wall.
  4. Door Size: As indicated on Drawings.
  5. Fire-Resistance Rating: Not less than that of adjacent construction.
  6. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory primed.
  7. Latch and Lock: Self-latching door hardware, operated by key.
- B. Fire-Rated, Flush Access Doors with Concealed Flanges:
1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
    - a. [Acudor Products, Inc.](#)
    - b. [Babcock-Davis.](#)
    - c. [Cendrex Inc.](#)
    - d. [JL Industries, Inc.; a division of the Activar Construction Products Group.](#)
    - e. [Karp Associates, Inc.](#)
    - f. [Metropolitan Door Industries Corp.](#)
    - g. [Nystrom, Inc.](#)
  2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
  3. Locations: Wall.
  4. Door Size: As indicated on Drawings.
  5. Fire-Resistance Rating: Not less than that of adjacent construction.
  6. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory primed.
  7. Latch and Lock: Self-closing, self-latching door hardware, operated by key.

## 2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

## 2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

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- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
  - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
- E. Latch and Lock Hardware:
  - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
  - 2. Keys: Furnish two keys per lock and key all locks alike.

## 2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

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3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
  - 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, Section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

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SECTION 083313 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-rated counter door assemblies.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for door-opening framing and corner guards.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type and size of coiling counter door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
5. Include diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

E. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.



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2. Bottom bar with sensor edge.
3. Guides.
4. Brackets.
5. Hood.
6. Laminate-clad counter panel product for each type, color, pattern, and surface finish; laminated to core.
7. Locking device(s).
8. Include similar Samples of accessories involving color selection.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For Installer and testing and inspecting agency.
  1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, section 5.2.3.1.
  2. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.
- C. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For coiling counter doors to include in maintenance manuals.
- C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
  1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
  1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.
  - 1. Obtain operators and controls from coiling counter door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
  - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
  - 2. Smoke Control: Where indicated, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. of door opening at 0.10 inch wg for both ambient and elevated temperature tests.

2.3 FIRE-RATED COUNTER DOOR ASSEMBLY

- A. Fire-Rated Counter Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
  - 1. **Basis-of-Design Product:** Subject to compliance with requirements, provide "CORNELL, AlarmGuard Tube Motor Operator Rolling Counter Fire Door, Model ERC10," or a comparable product by one of the following:
    - a. Clopay Building Products.
    - b. Cookson; a CornellCookson company.
    - c. Cornell; a CornellCookson Company.
    - d. Lawrence Roll-Up Doors, Inc.
    - e. Overhead Door Corporation.
    - f. Wayne Dalton; a division of Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Fire Rating: As indicated on drawings.
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 1-1/4-inch or 1-1/2-inch center-to-center height.

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- F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- G. Hood: Match curtain material and finish.
  - 1. Shape: Square.
  - 2. Mounting: Face of wall.
- H. Sill Configuration: No sill.
- I. Locking Devices: Equip door with locking device assembly.
- J. Locking Device Assembly: Single-jamb side locking bars, operable from inside and outside with cylinders.
- K. Electric Door Operator:
  - 1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
  - 2. Operator Location: Top of hood.
  - 3. Motor Exposure: Interior.
  - 4. Motor Electrical Characteristics:
    - a. Horsepower: 1 hp.
    - b. Voltage:
      - 1) 120-V ac, single phase, 60 Hz.
  - 5. Emergency Manual Operation: Push-up type.
  - 6. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.
    - a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.
  - 7. Control Station(s): Interior-side mounted.
- L. Curtain Accessories: Equip door with smoke seals, automatic closing device.
- M. Door Finish:
  - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND FABRICATION

- A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness

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and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

## 2.6 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.
  2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
- B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

## 2.7 LOCKING DEVICES

- A. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  1. Lock Cylinders: As specified in Section 087111 "Door Hardware (Descriptive Specification)"

## 2.8 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

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- C. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Release mechanism for motor-operated doors allows testing without mechanical release of the door. Automatic-closing device is to be designed for activation by the following:
  - 1. Replaceable fusible links with temperature rise and melting point of 165 deg F interconnected and mounted on both sides of door opening.
  - 2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
  - 3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
  - 4. Building fire-detection, smoke-detection, and -alarm systems.

## 2.9 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
  - 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  - 1. Comply with NFPA 70.
  - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

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- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
- D. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
- E. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
  - 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
  - 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
  - 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- F. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- G. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For fire-rated doors, activation delays closing.
  - 1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    - a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
- H. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
  - 1. Type: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- I. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- J. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

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- K. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.11 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

- A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
- B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Fire-Rated Doors: Install according to NFPA 80.
- D. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

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3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
  - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service is to include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.



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1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated service doors.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.

D. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

E. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.
2. Bottom bar with sensor edge.
3. Guides.
4. Brackets.
5. Hood.
6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

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1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For Installer.
- C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Special warranty.
- C. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
  - 1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design.”
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:

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1. Design Wind Load: As indicated on Drawings.
  2. Testing: According to ASTM E330/E330M.
  3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
- C. Seismic Performance: Overhead coiling doors are to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor: 1.0.

## 2.3 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
1. Basis-of-Design Product: Subject to compliance with requirements, provide “Thermiser”, Cornell; a Cornell Cookson company, or comparable product by one of the following:
    - a. ACME Rolling Doors.
    - b. Advanced Door Technologies.
    - c. Alpine Overhead Doors, Inc.
    - d. Alumatec Pacific Products.
    - e. ASTA Door Corporation.
    - f. C.H.I. Overhead Doors, Inc.
    - g. Clopay Building Products.
    - h. Cookson; a CornellCookson company.
    - i. Lawrence Roll-Up Doors, Inc.
    - j. McKeon Door Company.
    - k. Metro Door LLC.
    - l. Overhead Door Corporation.
    - m. Raynor Garage Doors.
    - n. Wayne Dalton; a division of Overhead Door Corporation.
    - o. Windsor Door.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283.
- D. Insulated Door Curtain R-Value: R-8.
- E. Door Curtain Material: Galvanized steel or aluminum.
- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
1. Insulated-Slat Interior Facing: Metal.
  2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel or aluminum extrusions and finished to match door.

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- H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- I. Hood: Match curtain material and finish.
  - 1. Shape: Round.
  - 2. Mounting: Face of wall as indicated on Drawings.
- J. Electric Door Operator:
  - 1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
  - 2. Operator Location: Top of hood.
  - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
  - 4. Motor Exposure: Interior.
  - 5. Motor Electrical Characteristics:
    - a. Horsepower: 1/2 hp.
    - b. Voltage: 115 V ac, single phase, 60 Hz.
  - 6. Emergency Manual Operation: Chain type.
  - 7. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.
    - a. Sensor Edge Bulb Color: Black.
  - 8. Control Station(s): Interior mounted.
- K. Door Finish:
  - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
  - 2. Factory Prime Finish: Manufacturer's standard color.
  - 3. Interior Curtain-Slat Facing: Finish as selected by Architect from manufacturer's full range.

2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

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1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
  2. Aluminum Door Curtain Slats: ASTM B209 sheet or ASTM B221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.
  3. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
  4. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch and minimum aluminum thickness of 0.032 inch.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

## 2.6 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.
  2. Aluminum: 0.040-inch-thick aluminum sheet complying with ASTM B209, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
- B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

## 2.7 LOCKING DEVICES

- A. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## 2.8 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.

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2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

## 2.9 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  1. Comply with NFPA 70.
  2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
  1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
  2. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
  1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
  2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
  3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
  1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

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- a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
- 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

## 2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.11 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## 2.12 STEEL AND GALVANIZED-STEEL FINISHES

- A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.



### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.
- D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

#### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
  - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

#### 3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.

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1. Complete installation and startup checks according to manufacturer's written instructions.
2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
  1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.
  1. Perform maintenance, including emergency callback service, during normal working hours.
  2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

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SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sectional-door assemblies.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type and size of sectional door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

C. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

D. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

E. Samples for Initial Selection: For units with factory-applied finishes.

1. Include Samples of accessories involving color selection.

F. Samples for Verification: For each type of exposed finish and for each color and texture required on the following components, in manufacturer's standard sizes:

1. Glazing.
2. Metal for door sections.

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3. Hardware.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For Installer.
- C. Sample Warranties: For manufacturer's warranty and finish warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For sectional doors to include in maintenance manuals.
- C. Manufacturer's warranty.
- D. Finish warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with provisions in the U.S. Department of Justice's "2010 ADA Standards for Accessible Design" applicable to sectional doors.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Failure of components or operators before reaching required number of operation cycles.
    - c. Faulty operation of hardware.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
    - e. Delamination of exterior or interior facing materials.
  - 2. Warranty Period: Five years from date of Substantial Completion.

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- B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain sectional doors from single source from single manufacturer.

- 1. Obtain operators and controls from sectional door manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

- 1. Design Wind Load: As indicated on Drawings.
  - 2. Testing: In accordance with ASTM E330/E330M.
  - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
    - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
    - b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.
  - 4. Operability under Wind Load: Design sectional doors to remain operable under design wind load, acting inward and outward.

- C. Seismic Performance: Provide sectional doors that withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

- 1. Component Importance Factor: 1.0.

### 2.3 SECTIONAL-DOOR ASSEMBLY

- A. Sectional Door: Provide steel sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Clopay Building Products

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- b. Overhead Door Corporation
  - c. Raynor Garage Doors
  - d. Rite-Hite Holding Corporation
  - e. Wayne Dalton; a division of Overhead Door Corporation
  - f. Windsor Door
- B. Sectional Door Style: Refer to door elevation in Drawings.
- C. Operation Cycles: Door components and operators capable of operating for not less than 50,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.
- D. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. when tested in accordance with ASTM E283 or DASMA 105.
- E. U-Value: 0.052 Btu/sq. ft. x h x deg F.
- F. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G90 zinc coating.
  - 1. Door-Section Thickness: 2 inches.
  - 2. Section Faces:
    - a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.
    - b. Exterior Face: Fabricated from single sheets, not more than 24 inches high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.
      - 1) Steel Sheet Thickness: 0.019-inch nominal coated thickness.
      - 2) Surface: Manufacturer's standard, wood-grain embossed.
    - c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:
      - 1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of 0.019 inch.
  - 3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.040-inch nominal coated thickness and welded to door section.
  - 4. Intermediate Stiles: Provide intermediate stiles formed from not less than 0.040-inch-thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.
  - 5. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.

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- a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
  - b. Hardware Locations: Provide reinforcement for hardware attachment.
6. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard insulation of type indicated below:
  - a. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
  - b. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.
- G. Track: Manufacturer's standard, galvanized-steel, standard-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.
  1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
  2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings.
  3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.
    - a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide continuous reverse angle attached to track and wall.
    - b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- H. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom top and jambs of door. Provide combination bottom weatherseal and sensor edge for bottom seal.
- I. Windows: Manufacturer's standard window units of shape and size and in locations indicated on Drawings. Set glazing in vinyl, rubber, or neoprene glazing channel. Provide removable stops of same material as door-section frames. Provide the following glazing:
  1. Insulating Glass Units: Manufacturer's standard.
- J. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.
  1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.
    - a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
    - b. Provide double-end hinges where required for doors more than 16 ft. wide unless otherwise recommended by door manufacturer in writing.

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2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.
3. Push/Pull Handles: Equip each door with galvanized-steel lifting handles on each side of door, finished to match door.

K. Locking Device:

1. Chain Lock Keeper: Suitable for padlock.
2. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

L. Counterbalance Mechanism:

1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.
  - a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
  - b. Provide one additional midpoint bracket for shafts up to 16 ft. long and two additional brackets at one-third points to support shafts more than 16 ft. long unless closer spacing is recommended in writing by door manufacturer.
3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 7 to 1.
4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

M. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
4. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
5. Operator Type: Manufacturer's standard for door requirements.
6. Motor: Reversible-type with controller (disconnect switch) for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.



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- a. Motor Size: 1/2 hp.
  - b. Electrical Characteristics:
    - 1) Phase: Single phase.
    - 2) Volts: 115 V.
7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
- a. Monitored Entrapment Protection: Electric sensor edge on bottom section designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.
  - b. Unmonitored Entrapment Protection: Pneumatic sensor edge, black, located within weatherseal mounted to bottom bar.
9. Control Station: Surface mounted, three-position (open, close, and stop) control.
- a. Operation: Push button.
  - b. Interior-Mounted Unit: Full-guarded, surface-mounted, standard-duty, weatherproof-type, NEMA ICS 6, Type 4 enclosure.
  - c. Exterior-Mounted Unit: Full-guarded, surface-mounted, standard-duty, weatherproof type, NEMA ICS 6, Type 4 enclosure.
  - d. Features: Provide the following:
    - 1) Explosion- and dust-ignition-proof control wiring.
    - 2) Audible and visual signals that comply with regulatory requirements for accessibility.
10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf.
11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- N. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- 1. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
    - a. Color and Gloss: As selected by Architect from manufacturer's full range.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.
- B. Tracks:
  - 1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
  - 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install automatic garage doors openers in accordance with UL 325.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean

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welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION

## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Aluminum-framed entrance and storefront systems.

- B. Related Requirements:

- 1. Section 079200 “Joint Sealants” for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section
  - 2. Section 084413 “Glazed Aluminum Curtain Walls” and 085113 “Aluminum Windows” for coordinating finish among aluminum fenestration units.
  - 3. Section 088000 “Glazing” for curtain wall glazing.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

- B. Product Data: For each type of product.

- 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Operating characteristics, electrical characteristics, and furnished accessories.

- C. Shop Drawings:

- 1. Plans, elevations, sections, full-size details, and attachments to other work.
  - 2. Details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 3. Full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrance and storefront systems, showing the following:

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- a. Joinery, including concealed welds.
  - b. Anchorage.
  - c. Expansion provisions.
  - d. Glazing.
  - e. Flashing and drainage.
4. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
5. Point-to-point wiring diagrams showing the following:
  - a. Power requirements for each electrically operated door hardware.
  - b. Location and types of switches, signal device, conduit sizes, and number and size of wires.
6. Signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.
- E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate door hardware as scheduled in Section 087111 "Door Hardware (Descriptive Specification)" with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- G. Delegated Design Submittal: For aluminum-framed entrances and storefronts including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
  1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Source Quality-Control Reports: For aluminum-framed entrance and storefront systems.
- E. Field Quality-Control Reports: For aluminum-framed entrance and storefront systems.
- F. Qualification Statements:
  1. For Installer and field testing agency.

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2. For egress door inspector.

a. Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.

G. Delegated Design Engineer Qualifications: For aluminum-framed entrance and storefront systems.

H. Sample Warranties: For aluminum-framed entrance and storefront systems.

1.6 CLOSEOUT SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Operation and Maintenance Data: For aluminum-framed entrances and storefronts.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by the International Accreditation Service or the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement as complying with ISO/IEC 17025.

D. Egress Door Inspector Qualifications:

1. Inspector for field quality-control inspections of egress door assemblies to comply with qualifications set forth in NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article "Inspection of Door Openings."

2. Inspector for field quality-control inspections of egress door assemblies to be certified under DHI's certification program as a Fire and Egress Door Assembly Inspector (FDAI) or a Certified Fire and Egress Door Assembly Inspector (CFDAI).

E. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

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1.8 WARRANTY

- A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
    - c. Cracking, peeling, or chipping.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain all components of aluminum-framed entrance and storefront system, including framing, insulated aluminum panels and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

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1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
1. Wind Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
1. Deflection Normal to Wall Plane: Limited to  $1/175$  of clear span for spans of up to 13 feet 6 inches and to  $1/240$  of clear span plus  $1/4$  inch for spans greater than 13 feet 6 inches.
  2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than  $1/8$  inch.
  3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
    - a. Perpendicular to Plane of Wall: No greater than  $1/240$  of clear span plus  $1/4$ -inch for spans greater than 11 feet 8- $1/4$  inches or  $1/175$  times span, for spans less than 11 feet 8- $1/4$  inches.
- E. Structural: Test in accordance with ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.
- G. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.6 at design displacement and 1.5 times the design displacement.



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H. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):
  - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.36 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
  - b. Entrance Doors: U-factor of not more than 0.43 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
2. Air Leakage:
  - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.
  - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. for pair doors or 0.50 cfm/sq. ft. for single door at a static-air-pressure differential of 1.57 lbf/sq. ft. when tested in accordance with ASTM E283.
3. Condensation Resistance Factor (CRF):
  - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 49 as determined in accordance with AAMA 1503.
  - b. Entrance Doors: CRF of not less than 41 as determined by AAMA 1503.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
  - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
  - b. Low Exterior Ambient-Air Temperature: 0 deg F.
  - c. Interior Ambient-Air Temperature: 75 deg F.

2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. **Basis-of-Design Product:** Subject to compliance with requirements, provide “YES 45 XT”; YKK AP America, Inc., or comparable product by one of the following:

1. [EFCO Corporation.](#)
2. [Kawneer North America; an Alcoa company.](#)
3. [Oldcastle Buiding Envelope™.](#)
4. [Tubelite Inc.](#)

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.

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2. Interior Vestibule Framing Construction: Nonthermal.
  3. Glazing System: Retained mechanically with gaskets on four sides.
  4. Glazing Plane: Center.
  5. Finish: High-performance organic finish.
  6. Fabrication Method: Field-fabricated stick system.
  7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  8. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Insulated Spandrel Panels:
1. Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
    - a. Overall Panel Thickness: 1 inch.
    - b. Exterior Skin: Aluminum.
      - 1) Thickness: Manufacturer's standard for finish and texture indicated.
      - 2) Finish: Match framing system.
      - 3) Texture: Smooth.
      - 4) Backing Sheet: 1/8-inch-thick tempered hardboard.
    - c. Interior Skin: Aluminum.
      - 1) Thickness: Manufacturer's standard for finish and texture indicated.
      - 2) Finish: Matching storefront framing.
      - 3) Texture: Smooth.
      - 4) Backing Sheet: 1/8-inch-thick tempered hardboard.
    - d. Thermal Insulation Core: Manufacturer's standard extruded-polystyrene board.
    - e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      - 1) Flame-Spread Index: 25 or less.
      - 2) Smoke-Developed Index: 450 or less.

## 2.4 ENTRANCE DOOR SYSTEMS

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide “MegaTherm 35XT (Advanced Thermal Commercial Swing Door)”; YKK AP America, Inc., or comparable product by one of the following:
1. C.R. Laurence Co., Inc.
  2. EFCO Corporation.

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3. [Kawneer North America; an Alcoa company.](#)
4. [Oldcastle Buiding Envelope™.](#)
5. [Tubelite Inc.](#)

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 2-3/8-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
2. Door Design: As indicated.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
  - a. Provide nonremovable glazing stops on outside of door.
4. Finish: Match adjacent storefront framing finish.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087111 "Door Hardware (Descriptive Specification)."

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

2.7 MATERIALS

- A. Sheet and Plate: ASTM B209.
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
  2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.

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3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## 2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
  3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.
- E. Rigid PVC filler.

## 2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Provisions for field replacement of glazing from interior.

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6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Storefront Framing: Fabricate components for assembly using screw-spline system.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
  2. At exterior doors, provide weather sweeps applied to door bottoms.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.10 ALUMINUM FINISHES

- A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
  1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
  2. Color and Gloss: As selected by Architect from manufacturer's full range.
  3. Coordinate finish color selection with color selections in Section 084413 "Glazed Aluminum Curtain Walls" and 085113 "Aluminum Windows."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.

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- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."
- B. Clean and protect glass as indicated in Section 088000 "Glazing."

3.4 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

- A. Install entrance doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
  - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.5 ERECTION TOLERANCES

- A. Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
  - 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
  - 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
  - 3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.

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- b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
  - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
- 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests: Perform the following tests on representative areas of aluminum-framed entrances and storefronts.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
    - a. Perform a minimum of two tests in areas as directed by Architect.
  - 2. Air Leakage: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
    - a. Perform a minimum of two tests in areas as directed by Architect.
  - 3. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.
- C. Inspection Agency: Engage a qualified inspector to perform inspections.
- D. Inspections:
  - 1. Egress Door Inspections: Inspect each aluminum-framed entrance door equipped with panic hardware, located in an exit enclosure, electrically controlled, and equipped with special locking arrangements, in accordance with NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article.
- E. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.7 MAINTENANCE SERVICE

- A. Entrance Door Hardware Maintenance:
  - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

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2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

3.8 ENTRANCE DOOR HARDWARE SETS

- A. See Section 087111 “Door Hardware (Descriptive Specification).”

END OF SECTION



## SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Glazed aluminum curtain wall systems.

- B. Related Requirements:

- 1. Section 079200 “Joint Sealants” for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section
  - 2. Section 084113 “Aluminum-Framed Entrances and Storefronts” and 085113 “Aluminum Windows” for coordinating finish among aluminum fenestration units.
  - 3. Section 088000 “Glazing” for curtain wall glazing.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

- B. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- C. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

- 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
    - a. Joinery, including concealed welds.

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- b. Anchorage.
  - c. Expansion provisions.
  - d. Glazing.
  - e. Flashing and drainage.
- 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- F. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data:
  - 1. For Installer and field testing agency.
  - 2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
- C. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
  - 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- D. Product Test Reports: For glazed aluminum curtain walls, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- E. Field quality-control reports.
- F. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors and that employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025 and acceptable to Owner and Architect.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

## 1.8 WARRANTY

- A. Special Assembly Warranty: Manufacturer and Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.
- B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  - 2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
  - 1. Wind Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
  - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans of greater than 13 feet 6 inches.
  - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
    - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
  - 3. Cantilever Deflection: Limited to 2l/175 at unsupported cantilevers.
- E. Structural: Test in accordance with ASTM E330/E330M as follows:
  - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

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1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft.
- G. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
  1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.6 at design displacement and 1.5 times the design displacement.
- H. Energy Performance: Certify and label energy performance according to NFRC as follows:
  1. Thermal Transmittance (U-factor):
    - a. Fixed glazing and Framing Areas: U-factor for the system of not more than 0.36 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
    - b. Operable Windows: As specified in Section 085113 “Aluminum Windows.”
  2. Air Leakage:
    - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.
    - b. Venting Windows: As specified in Section 085113 “Aluminum Windows.”
  3. Solar Heat-Gain Coefficient (SHGC):
    - a. Fixed Glazing and Framing Areas: SHGC of the system of not more than 0.49 as determined in accordance with NFRC 200.
    - b. Venting Windows: As specified in Section 085113 “Aluminum Windows.”
  4. Condensation Resistance Factor (CRF):
    - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 59 as determined in accordance with AAMA 1503.
    - b. Operable Windows: As specified in Section 085113 “Aluminum Windows.”
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
  1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
  2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
    - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    - b. Low Exterior Ambient-Air Temperature: 0 deg F.

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2.2 SOURCE LIMITATIONS

- A. Obtain all components of curtain-wall system, including framing, operable windows, and accessories, from single manufacturer.

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide “YCW 750 OGP, Outside Glazed Pressure Curtain Wall System with Polyamide Plates”; YKK AP America, Inc., or comparable product by one of the following:
1. EFCO Corporation.
  2. Kawneer Company, Inc.; Arconic Corporation.
  3. OldCastle BuildingEnvelope.
  4. TRACO, a division of Kawneer.
  5. Tubelite Inc.
  6. Wausau Window and Wall Systems; Apogee Wausau Group, Inc.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally broken.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Front.
  4. Finish: High-performance organic finish.
  5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  6. Steel Reinforcement: As required by manufacturer.
  7. System: Either stick or unitized system.
- C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
1. Include snap-on aluminum trim that conceals fasteners.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Insulated Spandrel Panels:
1. Laminated, metal faced flat panels with no deviations in plane exceeding 0.8 percent of the panel dimensions width and length.
    - a. Overall Panel Thickness: 1 inch.
    - b. Exterior Skin: Aluminum.
      - 1) Thickness: Manufacturer's standard for finish and texture indicated.
      - 2) Finish: High-performance organic finish.
      - 3) Texture: Smooth.
      - 4) Backing Sheet: Manufacturer's standard.
    - c. Interior Skin: Aluminum.

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- 1) Thickness: Manufacturer's standard for finish and texture indicated.
  - 2) Finish: High-performance organic finish.
  - 3) Texture: Smooth.
  - 4) Backing Sheet: Manufacturer's standard.
- d. Thermal Insulating Core: Manufacturer's standard rigid, closed cell polyisocyanurate board.
- e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- 1) Flame-Spread Index: 25 or less.
  - 2) Smoke-Developed Index: 450 or less.

F. Operable Windows:

1. As specified in Section 085113 "Aluminum Windows."

2.4 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard.
- C. Glazing Sealants: As recommended by manufacturer.

2.5 MATERIALS

- A. Sheet and Plate: ASTM B209 (ASTM B209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
  2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
  3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

2.6 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.

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3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

## 2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Provisions for field replacement of glazing from interior.
  6. Provisions for safety railings mounted on interior face of mullions.
  7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
  8. Components curved to indicated radii.
- D. Fabricate components to resist water penetration as follows:
  1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.
- F. Factory-Assembled Frame Units:
  1. Rigidly secure nonmovement joints.



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2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
  3. Seal joints watertight unless otherwise indicated.
  4. Install glazing to comply with requirements in Section 088000 "Glazing."
- G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

## 2.8 ALUMINUM FINISHES

- A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
  2. Color and Gloss: As selected by Architect from manufacturer's full range.
  3. Coordinate finish color selection with color selections in Sections 084113 "Aluminum-Framed Entrances and Storefronts" and 085113 "Aluminum Windows."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
- G. Seal joints watertight unless otherwise indicated.
- H. Metal Protection:

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1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
  2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
  - J. Install components plumb and true in alignment with established lines and grades.

### 3.3 INSTALLATION OF OPERABLE UNITS

- A. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

### 3.4 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."

### 3.5 ERECTION TOLERANCES

- A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:
  1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
  2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
  3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
  4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.
- C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

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1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
    - a. Perform a minimum of two tests in areas as directed by Architect.
  2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
    - a. Perform a minimum of two tests in areas as directed by Architect.
  3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.
- D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

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SECTION 085413 - FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fiberglass windows.

1.2 DEFINITIONS

- A. Combination Assemblies: Assemblies formed by a combination of two or more separate fenestration products whose frames are mullied together utilizing a combination mullion or reinforcing mullion.
- B. Combination Mullions: Horizontal or vertical members formed by joining two or more individual fenestration units together without a mullion stiffener.
- C. Reinforcing Mullions: Horizontal or vertical members with an added continuous mullion stiffener and joining two or more individual fenestration units along the sides of the mullion stiffener.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of fiberglass windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
3. Review and discuss the sequence of work required to construct a watertight and weather-tight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes.

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C. Shop Drawings:

1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, window rough openings, and details of installation, including anchor, flashing, and sealant installation.

D. Samples for Initial Selection: For units with factory-applied finishes, manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

1. Include Samples of hardware and accessories involving color selection.

E. Samples for Verification: Actual sample of finished products for each type of exposed finish:

1. Exposed Finishes: 2 by 4 inches.
2. Exposed Hardware: Full-size units.

F. Product Schedule: For fiberglass windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Test and Evaluation Reports:

1. Product Test Reports: For each fiberglass window, for tests performed by qualified testing agency.

C. Field Quality-Control Reports: For fiberglass windows.

D. Qualification Statements: For manufacturer and Installer.

E. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Warranty Documentation:

1. Manufacturers' special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating fiberglass windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

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- B. Installer Qualifications: An installer acceptable to fiberglass window manufacturer for installation of units required for this Project.
- C. Testing Agency Qualifications: An FGIA- or WDMA-accredited testing agency for testing indicated.

1.8 MOCKUPS

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup as indicated on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations by Change Order.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fiberglass windows to Project site in original, unopened packages and store them in accordance with manufacturer's written instructions. Protect fiberglass windows against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle fiberglass windows in a manner that prevents damage before, during, and after installation.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install fiberglass windows outside of limits recommended in writing by manufacturer.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fiberglass windows that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to meet performance requirements.
    - b. Structural failures, including excessive deflection, water leakage, and air infiltration.
    - c. Faulty operation of movable sash and hardware.
    - d. Deterioration of materials and finishes beyond normal weathering.
    - e. Failure of insulating glass.
  - 2. Warranty Period:

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- a. Window: 10 years from date of Substantial Completion.
- b. Glazing Units: 10 years from date of Substantial Completion.
- c. Hardware: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain fiberglass windows from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
  - 1. Window Certification: FGIA or WDMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
  - 1. Minimum Performance:
    - a. Class CW.
    - b. Grade 30.
  - 2. Mulled Window Systems: Evaluate and rate combination assemblies as single systems as determined by AAMA 450 in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 requirements.
- C. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
  - 1. Thermal Transmittance (U-factor): As determined in accordance with NFRC 100:
    - a. Fixed Windows: Not more than 0.26 Btu/sq. ft. x h x deg F.
    - b. Operable Windows: Not more than 0.32 Btu/sq. ft. x h x deg F.
  - 2. Solar Heat-Gain Coefficient (SHGC): As determined in accordance with NFRC 200:
    - a. Fixed Windows: Not more than 0.40.
    - b. Operable Windows: Not more than 0.36 as determined in accordance with NFRC 200.

2.3 FIBERGLASS WINDOWS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Marvin; Essential Collection.

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- B. General: Provide manufacturer's standard fiberglass window assemblies consisting of frames, sashes, glass, hardware, fasteners, and all components and accessories as required for a complete installation.
- C. Operating Types: Provide the following operating types in locations indicated on Drawings:
  - 1. Single hung.
  - 2. Fixed.
- D. Frames and Sashes: Pultruded fiberglass with insulating foam inserts complying with AAMA/WDMA/CSA 101/I.S.2/A440 and with exposed exterior fiberglass surfaces finished with manufacturer's standard enamel coating complying with AAMA 613.
  - 1. Exterior Color: As selected by Architect from manufacturer's full range.
  - 2. Interior Finish: Matching exterior finish, in color selected by Architect from manufacturer's full range.
- E. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.
  - 1. Kind: Fully tempered where indicated on Drawings.
- F. Insulating-Glass Units: ASTM E2190.
  - 1. Glass: ASTM C1036, Type 1, Class 1, q3.
    - a. Kind: Fully tempered where indicated on Drawings.
  - 2. Lites: Two.
  - 3. Filling: Fill space between glass lites with argon.
  - 4. Low-E Coating: Sputtered on second or third surface.
- G. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
- H. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock fiberglass windows, and sized to accommodate sash weight and dimensions.
  - 1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- I. Hung Window Hardware:
  - 1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
  - 2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only. Provide custodial locks.
  - 3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis to facilitate cleaning exterior surfaces from the interior.



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- J. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
  - 1. Exposed Fasteners: Avoid exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
- L. Mullions: Provide combination and reinforcing mullions and cover plates matching window units, complete with anchors for support to structure. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide reinforcing mullions and cover plates capable of withstanding design wind loads of window units.

## 2.4 ACCESSORIES

- A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.
  - 1. Quantity and Type: One permanently located between insulating-glass lites.
  - 2. Material: Manufacturer's standard.
  - 3. Pattern: As indicated on Drawings.
  - 4. Profile: As selected by Architect from manufacturer's full range.
  - 5. Color: As selected by Architect from manufacturer's full range.
- B. Jamb Extensions: Stain-grade Pacific Hemlock.
- C. Nail Fins: Manufacturer's standard mounting flanges with holes pre-punched for mechanical fasteners.

## 2.5 INSECT SCREENS

- A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
  - 1. Type and Location: Half, outside for single-hung sashes.
- B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
  - 1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.
  - 2. Finish for Exterior Screens: Matching color and finish of cladding.
- C. Aluminum Wire Fabric: 18-by-16-inch mesh of 0.011-inch-diameter, coated aluminum wire.
  - 1. Wire-Fabric Finish: Charcoal gray.

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2.6 FABRICATION

- A. Fabricate fiberglass windows in sizes indicated. Include a complete system for installing and anchoring windows.
- B. Glaze fiberglass windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Window Assemblies: Provide combination window units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
  - 1. Combination and reinforcing mullions with interior and exterior trim.
  - 2. Interior and exterior extension and trim.
  - 3. Clear pine head and seat boards.
  - 4. Top and bottom plywood platforms.
  - 5. Exterior head and sill casings and trim.
  - 6. Support brackets.
- E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FIBERGLASS WINDOWS

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

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- C. Mullions: Install combination and reinforcing mullions for combination assemblies in accordance with manufacturer's written instructions.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Test and inspect installed windows as follows:
  - 1. Testing Methodology: Testing of windows for air infiltration and water resistance to be performed in accordance with AAMA 502.
  - 2. Air-Infiltration Testing:
    - a. Test Pressure: As required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
    - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
  - 3. Water-Resistance Testing:
    - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    - b. Allowable Water Infiltration: No water penetration.
  - 4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows to be tested at 5 percent, 50 percent, and 90 percent completion.
  - 5. Test Reports: Prepared in accordance with AAMA 502.
  - 6. Windows will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows using manufacturer's written instructions. Remove excess sealants, glazing materials, dirt, and other substances.
  - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

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- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:
  - a. Swinging doors.
  - b. Sliding doors.
2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Requirements:

1. Section 083113 "Access Doors and Frames" for access door hardware except cylinders.
2. Section 102219 "Demountable Partitions" for hardware not specified in this section.
3. Section 281000 "Access Control for coordination of access control system components.
4. Section 281400 "Access Control System Hardware" for access control system units, power, battery chargers and computer equipment.
5. Section 284621.11 "Addressable Fire-Alarm Systems" for connections to building fire alarm system.

1.2 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.

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1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: For electrified door hardware.
  - 1. Include diagrams for power, signal, and control wiring.
    - a. Utilize SOM Building Control Wiring Appendix Set for reference.
  - 2. Include details of interface of electrified door hardware and building safety and security systems.
- D. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
  - 1. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- E. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - 1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
  - 2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
  - 3. Content: Include the following information:
    - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
    - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
    - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
    - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
    - e. Fastenings and other installation information.
    - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
    - g. Mounting locations for door hardware.
    - h. List of related door devices specified in other Sections for each door and frame.
- F. Keying Schedules: Keying shall be performed by Owner

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1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Certificates: For each type of electrified door hardware.
  - 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- C. Schedules: Final door hardware schedule.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
  - 1. Warehousing Facilities: In Project's vicinity.
  - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
  - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

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1. State of Maine, BGS Lock Shop  
Attn: Gary Tibbetts  
15 Columbia St.  
Augusta, ME 04330

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection, cracking, or breakage.
    - b. Faulty operation of doors and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
    - a. Exit Devices: Two years from date of Substantial Completion.
    - b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers: Only hardware manufactured by one of the companies indicated below shall be accepted for use in the Project, and acceptance is limited only to the category of hardware for which the manufacturer is specified or listed as an acceptable equal.
  1. Hinges: McKinney, Stanley
  2. Electrified Hinges, Power Transfers: Marray, SDC (Security Door Controls), Sargent, Von Duprin, Keedex, Securitron)
  3. Mortise Locksets: Sargent, Schlage
  4. Exit Devices: Sargent, Von Duprin
  5. Flush Bolts: Rockwood, Sargent
  6. Door Closers: LCN, Sargent
  7. Power Door Operators: Horton, no substitutes
  8. Door Stops: Glynn Johnson, Ives, Rockwood
  9. Push/Pulls: Rockwood, Burns, Ives
  10. Protective Plates: Rockwood, Burns, Ives
  11. Thresholds, Weather-stripping, Rain Drips: NGP, Pemko, Reese
  12. Silencers: Rockwood
  13. Power Supplies: Altronix unless otherwise specified.
  14. Magnetic Locks: Securitron, Schlage
  15. Keys and Cores: KABA 7-Pin SFIC, no substitutions
  16. Specialty Key Switches: Medeco M3, no substitutions
  17. Key Cabinet: Telkee
  18. Fire Department Lock Box: Knox Co.



## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- B. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Electrically Operated and/or Controlled Hardware:
  - 1. All Power Supplies shall be centrally located with the associated Access Control Panel and not individually at each opening.
  - 2. All Power Supplies are to be mains powered from generator circuits when available.
- C. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
  - 2. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
    - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
  - 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
  - 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

## 2.3 KEYS AND CORES

- A. All Key Blanks and Cores shall be drop shipped:
  - 1. State of Maine, BGS Lock Shop  
Attn: Gary Tibbetts  
15 Columbia St.  
Augusta, ME 04330

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2. Products:

Primary Lock Cores

- Shall be 7-Pin Small Format Interchangeable Core (SFIC)
  - a. Cores: KABA 3850-25-1007 PK1
  - b. Keys: KABA 3800-00-0003-PK1-C95W21

Specialty Switch Locks

- c. Medeco M3 “1 switch, Maintained 2 Key pull” sub-assembled.
  - . 652150T 012 (S)
  - . CP-270511 Lead Wires - Required Accessory

2.4 FIRE DEPARTMENT LOCK BOX

- A. Fire Department Lock Box: Shall be Knox Co. model 4412 or 4442 Dual Lock with Tamper switches wired to the Access Control System.
- B. Secondary Lock shall be keyed to Knox system ID KX-48-007-08-01

2.5 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
  - 1. All exterior and interior with Access Control System shall be NRP (Non-Removable Pin) design

2.6 ELECTRIFIED HINGES, POWER TRANSFER

A. Products:

- 1. Von Duprin EPT2
- 2. Securitron EPT, CEPT
- 3. Marray TEF2+4
- 4. SDC PTH2-4
- 5. Keedex K-DL38A

2.7 DOOR CLOSERS

A. Approved Products:

- 1. Exterior: LCN 4040XP -CUSH Sargent 281-CPS
- 2. Interior: LCN 4040XP 1461 Sargent 281-0  
LCN 1461 Sargent 281-P9

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2.8 POWER DOOR OPERATOR (LOW ENERGY)

A. General:

1. Shall be integrated with Access Control System on controlled openings
2. All actuator buttons shall be hardwired, no wireless accepted.

B. Approved Product:

1. Exterior Horton 4100 series
2. Interior Horton 7100 series

2.9 EXIT DEVICES

A. Approved Products: Sargent

1. Functions:

- a. 70-56-8806-ETL
- b. 70-56-8506-ETL
- c. 70-12-56-8806-ETL
- d. 70-8806-ETL
- e. 70-12-8806-ETL
- f. 8815-ETL
- g. 12-8815-ETL

2.10 MORTISE LEVER SETS

A. Products: Sargent 8200 Series

1. Functions:

- a. Stockroom – 70-8204-LNL ANSI F07
- b. Entry / Office – 70- 8205-LNL ANSI F04
- c. Break or Conference – 70-8257-LNL
- d. Privacy – 70-50- 8267-LNL ANSI F26
- e. Elec Fail-Secure – 70-8271-LNL
- f. Elec. Fail-Safe – 70-8270-LNL
- g. Elec. Asylum Fail-Safe – 70-8272-LNL

B. Implementation:

2. The Shelter-In-Place “SIP Protocol” adopted by Owner requires that all rooms be lockable from the inside where possible. To this end Owner provides lock hardware on nearly any door that can be fitted with one without causing day to day inconvenience to employees.
  - a. Individual Offices shall be fitted with Functions b.
  - b. Rooms utilized by more than two people or common areas; Conference, Break, Copier rooms shall be fitted with Function c.
  - c. Restrooms, Showers, Locker, Nursing rooms shall be fitted with Function d.

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2.11 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.
  - 1. Utilize “Combination Flush Bolts” such as Rockwood 2845 and 2945.

2.12 ELECTROMECHANICAL LOCKS

- A. NOT ALLOWED
- ~~B. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full exterior or full interior type, as required by application indicated.~~

2.13 ELECTRIC STRIKES

- A. Products:
  - 1. For Rim Exit Devices: 9400, 9500, 9600 by HES
  - 2. For Mortised / Cylindrical Devices: 1006, 1600 by HES

2.14 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.
- B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: BHMA A156.22.

2.15 WEATHER STRIPPING

- A. Sweeps shall be of a brush design.

2.16 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.17 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

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2.18 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights **to comply with the following** unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

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- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
  - 1. Furnish permanent cores to Owner for installation.
- E. Stops: Provide wall stops for doors unless floor or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- F. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
  - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- G. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- H. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
  - 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
  - 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

### 3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

### 3.6 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

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3.7 DOOR HARDWARE SETS

<b>Door Hardware Set No. EH-1, Doors: E01, E03, E13, and 100A</b>		
2	Continuous Hinges	Stanley, prepped for power hinge
2	Power Transfer Hinges	Von Duprin, EPT2, power transfer
2	Exit Devices	Von Duprin 9827 Series, Quiet Electric Latch Retraction, function L, Key locks and unlocks with electrified lever operation.
2	Lever	Von Duprin, Standard lever profile 07
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
1	Card Reader	HID Signo Priority Seos Profile Reader, Model 40
2	Power Door Operators	Horton 4100 series (exterior)
1	Power Door Operator Integration Relay Module	BEA MC-25
1	Power Supply	
2	Door position switches	GE Interlogix-1078C
1 set	Weatherstripping	
	Head	Pemko; “2891 Series”.
	Jamb	Pemko; “285 Series”.
	Meeting Rail	Pemko; “354 Series”.
	Door sweep	Pemko; “315 Series”.
1	Threshold	Pemko “1710 Series”.
1	Knox Box (Door E01 Only)	Model 4442 Dual Lock with Tamper Switch
* See Division 08 Section “Automatic Door Operators” for specification of operators.		
**Coordinate with Division 28 ELECTRONIC SAFETY AND SECURITY for access control hardware and fire alarm connections.		
*** Coordinate power supply requirements for connection to/with adjacent doors indicated on Drawings.		

<b>Door Hardware Set No. EH-2, Doors:</b>		
2	Continuous Hinges	Stanley, prepped for power hinge
2	Power Transfer Hinges	Von Duprin, EPT2, power transfer
2	Exit Devices	Von Duprin 9827 Series, Quiet Electric Latch Retraction, function L, Key locks and unlocks with electrified lever operation.
2	Lever	Von Duprin, Standard lever profile 07
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
1	Card Reader	HID Signo Priority Seos Profile Reader, Model 40
2	Power Door Operators	Horton 4100 series (exterior)
1	Power Door Operator Integration Relay Module	BEA MC-25
1	Power Supply	
2	Door position switches	GE Interlogix-1078C
1 set	Weatherstripping	
	Head	Pemko; “2891 Series”.

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	Jamb	Pemko; “285 Series”.
	Meeting Rail	Pemko; “354 Series”.
	Door sweep	Pemko; “315 Series”.
* See Division 08 Section “Automatic Door Operators” for specification of operators.		
**Coordinate with Division 28 ELECTRONIC SAFETY AND SECURITY for access control hardware and fire alarm connections.		
*** Coordinate power supply requirements for connection to/with adjacent doors indicated on Drawings.		

<b>Door Hardware Set No. EH-3, Doors: E02, E04, E07, E08, E09, E10, E12</b>		
2	Hinges	Stanley, 5 Knuckle, ball bearing, heavy weight full mortise hinge
1	Power Transfer Hinges	Von Duprin, EPT2, power transfer
1	Exit Devices	Von Duprin, 98 Rim Exit Device, Function 03
1	Lever	Von Duprin, Standard lever profile 07
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
1	Card Reader	HID Signo Priority Seos Profile Reader, Model 40
1	Electric Strike	HES 9600 Series, Surface Mounted
1	Closers	LCN; “4040XP Series (parallel arm)”
1	Power Supply	
1	Door position switches	GE Interlogix-1078C
1 set	Weatherstripping	
	Head	Pemko; “2891 Series”.
	Jamb	Pemko; “285 Series”.
	Meeting Rail	Pemko; “354 Series”.
	Door sweep	Pemko; “315 Series”.
1	Threshold	Pemko “1710 Series”.
**Coordinate with Division 28 ELECTRONIC SAFETY AND SECURITY for access control hardware and fire alarm connections.		
*** Coordinate power supply requirements for connection to/with adjacent doors indicated on Drawings.		

<b>Door Hardware Set No. HW-1, Doors: S1A, S1B, S1C, S1D, S2A, S2B, S3A, S3A1, S3B, S3B1, S3C1, S3D, M1, AND M2</b>		
3	Hinges	Stanley, 5 Knuckle, ball bearing, heavy weight full mortise hinge
1	Exit Devices	Von Duprin, 98 Rim Exit Device, Function 03
1	Lever	Von Duprin, Standard lever profile 07
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
1	Card Reader	HID Signo Priority Seos Profile Reader, Model 40
1	Electric Strike	HES 1600 Series
1	Closers	LCN; “4040XP Series (parallel arm)”
1	Power Supply	



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1	Door position switches	GE Interlogix-1078C
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** Coordinate power supply requirements for connection to/with adjacent doors indicated on Drawings.		

<b>Door Hardware Set No. HW-2, Doors:</b>		
3	Hinges	Stanley, 5 Knuckle, ball bearing, heavy weight full mortise hinge
1	Lockset	Sargent; “8200 Mortise Locks”, Privacy, F26
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
1	Closers	LCN; “4040XP Series (parallel arm)”
1	Door Stop	Ives; “FS13 Dome (floor)/WS401CVS Convex (wall)”

<b>Door Hardware Set No. HW-3, Doors:</b>		
3	Hinges	Stanley, 5 Knuckle, ball bearing, heavy weight full mortise hinge
1	Lockset	Sargent; “8200 Mortise Locks”, Storeroom 07
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
1	Card Reader	HID Signo Priority Seos Profile Reader, Model 40
1	Electric Strike	HES 1600 Series
1	Closers	LCN; “4040XP Series (parallel arm)”
1	Power Supply	
1	Door position switches	GE Interlogix-1078C
1	Door Stop	Ives; “FS13 Dome (floor)/WS401CVS Convex (wall)”
*Coordinate with Division 28 ELECTRONIC SAFETY AND SECURITY for access control hardware and fire alarm connections.		
** Coordinate power supply requirements for connection to/with adjacent doors indicated on Drawings.		

<b>Door Hardware Set No. HW-3A, Doors:</b>		
6	Hinges	Stanley, 5 Knuckle, ball bearing, heavy weight full mortise hinge
1	Lockset	Sargent; “8200 Mortise Locks”, Storeroom 07
1	Dummy Lockset Trim	
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
2	Closers	LCN; “4040XP Series (parallel arm)”
1 set	Manual Flush Bolts	Rockwood 2845
1	Door Stop	Ives; “FS13 Dome (floor)/WS401CVS Convex (wall)”

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<b>Door Hardware Set No. HW-4, Doors:</b>		
1	Lockset	Sargent; “8200 Mortise Locks”, Storeroom 07
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.

<b>Door Hardware Set No. HW-5, Doors:</b>		
	Hinges	By Demountable Partition Manufacturer
1	Lockset	Sargent; “8200 Mortise Locks”, Storeroom 07
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
1	Door Stop	Ives; “FS13 Dome (floor)/WS401CVS Convex (wall)”

<b>Door Hardware Set No. HW-5A, Doors:</b>		
3	Hinges	Stanley, 5 Knuckle, ball bearing, heavy weight full mortise hinge
1	Lockset	Sargent; “8200 Mortise Locks”, Entry/Office 04
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
1	Door Stop	Ives; “FS13 Dome (floor)/WS401CVS Convex (wall)”

<b>Door Hardware Set No. HW-5B, Doors: 102A, 102B, 102C and 167A</b>		
3	Hinges	Stanley, 5 Knuckle, ball bearing, heavy weight full mortise hinge
1	Lockset	Sargent; “8200 Mortise Locks”, Entry/Office 04
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
1	Closers	LCN; “4040XP Series (parallel arm)”
1	Door Stop	Ives; “FS13 Dome (floor)/WS401CVS Convex (wall)”

<b>Door Hardware Set No. HW-6, Doors:</b>		
1	Lockset	Sargent; “8200 Mortise Locks”, Storeroom 07
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.

<b>Door Hardware Set No. HW-7, Doors:</b>		
3	Hinges	Stanley, 5 Knuckle, ball bearing, heavy weight full mortise hinge
1	Lockset	Sargent; “8200 Mortise Locks”, Entry/Office 04
1	Cylinder	Dormakaba; “KABA 3850-25-1007 PK1”.
1	Card Reader	HID Signo Priority Seos Profile Reader, Model 40
1	Electric Strike	HES 1600 Series
1	Closers	LCN; “4040XP Series (parallel arm)”
1	Power Supply	
1	Door position switches	GE Interlogix-1078C
1	Door Stop	Ives; “FS13 Dome (floor)/WS401CVS Convex (wall)”
*Coordinate with Division 28 ELECTRONIC SAFETY AND SECURITY for access control hardware and fire alarm connections.		
** Coordinate power supply requirements for connection to/with adjacent doors indicated on Drawings.		

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<b>Door Hardware Set No. HW-8, Doors:</b>		
4	Hinges	Stanley, 5 Knuckle, ball bearing, heavy weight full mortise hinge
2	Power Transfer Hinges	Von Duprin, EPT2, power transfer
2	Exit Devices	Von Duprin 9827 Series, Quiet Electric Latch Retraction, function L, Key locks and unlocks with electrified lever operation.
2	Lever	Von Duprin, Standard lever profile 07
1	Cylinder	Dormakaba; "KABA 3850-25-1007 PK1".
1	Card Reader	HID Signo Priority Seos Profile Reader, Model 40
2	Closers	LCN; "4040XP Series (parallel arm)"
1	Power Supply	
2	Door position switches	GE Interlogix-1078C
*Coordinate with Division 28 ELECTRONIC SAFETY AND SECURITY for access control hardware and fire alarm connections.		
** Coordinate power supply requirements for connection to/with adjacent doors indicated on Drawings.		

<b>Door Hardware Set No. HW-9, Doors:</b>		
1	Cylinder	Dormakaba; "KABA 3850-25-1007 PK1".
1	Door position switches	GE Interlogix-2315A
*Coordinate with Division 28 ELECTRONIC SAFETY AND SECURITY for access control hardware and fire alarm connections.		
** Coordinate power supply requirements for connection to/with adjacent doors indicated on Drawings.		

END OF SECTION

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SECTION 087113 - AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Power door operators for swinging doors.

1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- C. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
- D. For automatic door terminology, see BHMA A156.10 and BMHA A156.19 for definitions of terms.

1.4 COORDINATION

- A. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing automatic door operators.
- B. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.
- C. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to power supplies and access-control system.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

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1.6 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings: For automatic door operators.
  - 1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
  - 2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Indicate locations of activation and safety devices.
  - 4. Include diagrams for power, signal, and control wiring.
  - 5. Include plans, elevations, sections, and attachment details for guide rails.
- D. Samples: For each exposed product and for each color and texture specified, manufacturer's standard size.

1.7 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For Installer and Certified Inspector.
- C. Sample Warranties: For manufacturer's special warranties.

1.8 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project and who employs a Certified Inspector.

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1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Certified Inspector Qualifications: Certified by AAADM.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Faulty or sporadic operation of automatic door operator, including controls.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.
  2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Besam Entrance Solutions; ASSA ABLOY.
  2. DORMA Automatics; Div of DORMA Group North America.
  3. Horton Automatics; a division of Overhead Door Corporation.
  4. LCN; an Allegion brand.
  5. SARGENT Manufacturing Company; ASSA ABLOY.
  6. Stanley Access Technologies.
- B. Source Limitations: Obtain automatic door operators, including activation and safety devices, from single source from single manufacturer.

2.2 AUTOMATIC DOOR OPERATORS, GENERAL

- A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and according to UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
  1. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load indicated on Drawings.

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- B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.
- C. Hinges: See Section 087111 "Door Hardware (Descriptive Specification)" for hinge type for each door that door operator shall accommodate.
- D. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch- thick, extruded or formed aluminum; manufacturer's standard width; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.
- E. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 LOW-ENERGY DOOR OPERATORS FOR SWINGING DOORS

- A. Standard: BHMA A156.19.
- B. Performance Requirements:
  - 1. Opening Force if Power Fails: Not more than 15 lbf required to release latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
  - 2. Entrapment-Prevention Force: Not more than 15 lbf required to prevent stopped door from closing or opening.
- C. Configuration: Operator to control single swinging door.
  - 1. Traffic Pattern: Two way.
  - 2. Operator Mounting: Surface.
- D. Operation: Power opening and spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.
- E. Operating System: Electromechanical.
- F. Microprocessor Control Unit: Solid-state controller.
- G. Features:
  - 1. Adjustable opening and closing speed.
  - 2. Adjustable opening and closing force.
  - 3. Adjustable backcheck.
  - 4. Adjustable hold-open time from zero to 30 seconds.

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5. Adjustable time delay.
6. Adjustable acceleration.
7. Obstruction recycle.
8. On-off/hold-open switch to control electric power to operator.

H. Activation Device: Push-plate switch on each side of door to activate door operator.

I. Exposed Finish: Baked-enamel or powder-coat finish.

1. Color: As selected by Architect from full range of available colors.

## 2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B 221.
2. Sheet: ASTM B 209.

B. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

## 2.5 CONTROLS

A. General: Provide controls, including activation and safety devices, according to BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

B. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.

1. Configuration: Rectangular push plate with 2-by-4-inch junction box.
  - a. Mounting: As indicated on Drawings.
2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
3. Message: International symbol of accessibility and "Push to Open."

C. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

## 2.6 FABRICATION

A. Factory fabricate automatic door operators to comply with indicated standards.



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- B. Form aluminum shapes before finishing.
- C. Fabricate exterior components to drain condensation and water passing joints within operator enclosure to the exterior.
- D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

2.7 ACCESSORIES

- A. Signage: As required by cited BHMA standard for type of door and its operation.
  - 1. Application Process: Operator manufacturer's standard process.
  - 2. Provide sign materials with instructions for field application when operators are installed.

2.8 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

- A. General: Install automatic door operators according to manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.
  - 1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
  - 2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.
- B. Controls: Install activation and safety devices according to manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Access-Control System: Connect operators to access-control system as specified in Section 281300 "Access Control."
- D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

3.3 FIELD QUALITY CONTROL

- A. Certified Inspector: Manufacturer's Certified Inspector shall test and inspect components, assemblies, and installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test and inspect each automatic door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.
- C. Automatic door operators will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
  - 1. Adjust operators on exterior doors for weathertight closure.
- B. After completing installation of automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.
- C. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

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- D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of automatic door operator Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
  - 2. Perform maintenance, including emergency callback service, during normal working hours.
  - 3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic door operators.

END OF SECTION

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Glass products.
  - 2. Security (laminated) glass.
  - 3. Insulating glass.
  - 4. Glazing sealants.
  - 5. Glazing tapes.
  - 6. Miscellaneous glazing materials.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.5 PREINSTALLATION MEETING

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review temporary protection requirements for glazing during and after installation.

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1.6 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For Installer, manufacturers of insulating-glass units with sputter-coated, low-E coatings, glass testing agency and sealant testing agency.
- C. Product Certificates: For glass.
- D. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.
  - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- E. Preconstruction adhesion and compatibility test report.
- F. Sample warranties.

1.8 QUALITY ASSURANCE

- A. Fabricated Glass Manufacturer Qualifications: A qualified manufacturer who is approved and certified by primary glass manufacturer.
- B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

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1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain tinted and coated glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
  - 1. Design Wind Pressures: Determine design wind pressures applicable to Project in accordance with ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Wind Design Data: As indicated on Drawings.
  - 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick of thickness indicated.
  - 2. For laminated-glass lites, properties are based on products of construction indicated.
  - 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  - 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  - 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  - 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

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- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
  - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
  - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AGC Glass Company North America, Inc.
    - b. Cardinal Glass Industries, Inc.
    - c. Guardian Glass LLC.
    - d. Pilkington North America; NSG Group.
    - e. Vitro Architectural Glass.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- C. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cardinal Glass Industries, Inc.
    - b. Guardian Glass LLC.
    - c. Pilkington North America; NSG Group.
    - d. Viracon, Inc.
    - e. Vitro Architectural Glass.
- D. Bird Friendly Glass Systems:



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1. Basis-of-Design Product: Subject to compliance with requirements, provide "AviProtek-E Low-e coated Bird Friendly Glass, Walker Glass Company Ltd." Pattern to be "Dots & Squares, 217, 2"x2"-5mm Dots.

2.5 SECURITY (LAMINATED) GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide "SG4" School Guard Glass, or a comparable product.
  2. Construction: Laminate glass with custom security, heat strengthened, chemically bonded core interlayer to comply with manufacturer's written instructions.
  3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  4. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
  1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
  2. Perimeter Spacer: Aluminum with black, color anodic finish.
  3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

- A. General:
  1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.
- B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; Dow Corning® 791 Silicone Weatherproofing Sealant.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS2800 SilGlaze II.

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- c. [May National Associates, Inc.; a subsidiary of Sika Corporation](#); Bondaflex Sil 295.
- d. [Pecora Corporation](#); 895NST.
- e. [Polymeric Systems, Inc.](#); PSI-641.
- f. [Tremco Incorporated](#); Spectrem 2

## 2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
  - 1. AAMA 804.3 tape, where indicated.
  - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
  - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
  - 1. EPDM or silicone with Shore A durometer hardness of 85, plus or minus 5.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
  - 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- E. Edge Blocks:
  - 1. EPDM or silicone with Shore A durometer hardness per manufacturer's written instructions.

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2. Type recommended in writing by sealant or glass manufacturer.

- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
- a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

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3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior, as specified.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

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- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.

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- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 INSULATING GLASS SCHEDULE

- A. Low-E Coated, Clear Insulating Glass Type:
  - 1. Basis-of-Design Product: “LoE-270 #2,” Cardinal Glass.
  - 2. Overall Unit Thickness: 1 inch.
  - 3. Minimum Thickness of Each Glass Lite: 6 mm.
  - 4. Outdoor Lite: Clear, fully tempered float glass.
  - 5. Interspace Content: Argon.
  - 6. Indoor Lite: Fully tempered float glass.
  - 7. Low-E Coating with Bird Friendly Glass: Pattern 217, 2"x2"-5mm Dots on first surface and pyrolytic or sputtered Low-E coating on second surface.
  - 8. Winter Nighttime U-Factor: 0.25 maximum.
  - 9. Summer Daytime U-Factor: 0.22 maximum.
  - 10. Visible Light Transmittance: 70 percent minimum.
  - 11. Solar Heat Gain Coefficient: 0.37 maximum.
  - 12. Safety glazing required.

3.9 INSULATING SECURITY (LAMINATED) GLAZING SCHEDULE

- A. Low-E Coated, Clear Insulating Laminated Glass Type:
  - 1. Basis-of-Design Product: “SGG-IG16 SG4 with Vitro Solarban 60 Low-E Insulated Glass Unit,” School Guard Glass.
  - 2. Overall Unit Thickness: 1 inch.
  - 3. Minimum Thickness of Outdoor Lite: 6 mm.
  - 4. Outdoor Lite: Clear, fully tempered float glass.
  - 5. Interspace Content: Argon.
  - 6. Indoor Lite: Clear laminated glass with two plies of annealed float glass.
    - a. Minimum Thickness of Each Glass Ply: 6 mm.
    - b. Interlayer Thickness: 0.060 inch.
  - 7. Low-E Coating with Bird Friendly Glass: Pattern 217, 2"x2"-5mm Dots on first surface and pyrolytic or sputtered Low-E coating on second surface.
  - 8. Winter Nighttime U-Factor: 0.25 maximum.

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9. Summer Daytime U-Factor: 0.22 maximum.
10. Visible Light Transmittance: 67 percent minimum.
11. Solar Heat Gain Coefficient: 0.38.
12. Safety glazing required.

END OF SECTION

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SECTION 088813 - FIRE-RATED GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Fire-protection-rated glazing.
  - 2. Fire-resistance-rated glazing.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Glass Samples: For each type of glass product; 12 inches square.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.



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1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For installers.
- C. Product Certificates: For each type of glass and glazing product, from manufacturer.
- D. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during the remainder of the construction period.

1.10 WARRANTY

- A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

- 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

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- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

## 2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

## 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
- B. Safety Glazing Labeling: Permanently mark glazing with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

## 2.4 GLASS PRODUCTS

- A. Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- B. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 1. Construction: Laminate glass with polyvinyl butyral interlayer unless fire-protection or fire-resistance rating is based on another product.
  - 2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
  - 3. Interlayer Color: Clear unless otherwise indicated.

## 2.5 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.
  - 1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.

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- B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.
- C. Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 5-mm thickness; faced on one surface with a clear glazing film; and complying with 16 CFR 1201, Category II.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "FireLite NT;" Technical Glass Products or comparable product by one of the following:
    - a. Interedge Technologies by AGC flat Glass; Pyran Platinum F.
    - b. SAFTI FIRST Fire Rated Glazing Solutions.
    - c. Schott North America, Inc.
    - d. Vetrotech Saint-Gobain.

## 2.6 FIRE-RESISTANCE-RATED GLAZING

- A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing according to ASTM E 119 or UL 263.
- B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that the glazing is approved for use in walls, and the fire-resistance rating in minutes.
- C. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, ultraclear float glass; with intumescent interlayers; and complying with 16 CFR 1201, Category II.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "Pyrostop;" Technical Glass Products or comparable product by one of the following:
    - a. AGC Glass Company North America, Inc.
    - b. Pilkington North America.
    - c. SAFTI FIRST Fire Rated Glazing Solutions.
    - d. Technical Glass Products.
    - e. Vetrotech Saint-Gobain.

## 2.7 GLAZING ACCESSORIES

- A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

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- B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
    - a. Dow Corning Corporation; 795.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.; SilGlaze II SCS2800.
    - c. Tremco Incorporated; Spectrem 2.
  - 2. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- C. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
  - 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- C. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

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2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.
- B. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

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- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites with proper orientation so that coatings face fire side or protected side as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

### 3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant, where indicated.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

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3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial washaway from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

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SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Fixed extruded-aluminum louvers.
  - 2. Blank-off panels for louvers
- B. Related Requirements:
  - 1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
  - 2. Section 081416 "Flush Wood Doors" for louvers in flush wood doors.
  - 3. Section 084113 "Aluminum-Framed Entrances and Storefronts" and 085450 "Composite Windows" for coordinating finish among aluminum fenestration units.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).
- C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- D. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.



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- C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
  - 1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
  - 2. Show mullion profiles and locations.
- D. Samples: For each type of metal finish required.
- E. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- C. Sample Warranties: For manufacturer's special warranties.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 WARRANTY

- A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
  - 1. Wind Loads: Determine loads based on pressures as indicated on drawings.
- C. Seismic Performance: As indicated on drawings.
- D. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. Component Importance Factor: 1.0.
- E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- G. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal Drainable-Blade Louver:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "ESD-635," Greenheck Fan Corporation, or comparable product by one of the following:
    - a. Airolite Company, LLC (The).
    - b. Architectural Louvers; Harray, LLC.

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- c. [Arrow United Industries.](#)
  - d. [Cesco Products; a division of MESTEK, Inc.](#)
  - e. [Construction Specialties, Inc.](#)
  - f. [Nystrom, Inc.](#)
  - g. [Ruskin Company.](#)
  - h. [United Enertech Corporation.](#)
  - i. [Vent Products Co., Inc.](#)
- 2. Louver Depth: 6 inches.
  - 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
  - 4. Mullion Type: Exposed.
  - 5. Louver Performance Ratings:
    - a. Free Area: Not less than 9.4 sq. ft. for 48-inch- wide by 48-inch- high louver.
    - b. Point of Beginning Water Penetration: Not less than 1077 fpm.
    - c. Air Performance: Not more than 0.10-inch wg static pressure drop at 6,000-cfm free-area intake velocity.
    - d. Coordinate louver performance with mechanical drawings and schedules.
  - 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

## 2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
  - 1. Screen Location for Fixed Louvers: Interior face.
  - 2. Screening Type: Insect screening.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
  - 1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
  - 2. Finish: Same finish as louver frames to which louver screens are attached.
  - 3. Type: Rewirable frames with a driven spline or insert.
- D. Louver Screening for Aluminum Louvers:
  - 1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.
  - 2. Insect Screening: Stainless steel, 18-by-18 mesh, 0.009-inch wire.

## 2.5 BLANK-OFF PANELS

- A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
  - 1. Thickness: 1 inch.
  - 2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
  - 3. Insulating Core: Extruded-polystyrene foam.

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4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same type of finish applied to louvers, but black color.
7. Attach blank-off panels with clips.

## 2.6 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
  1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
  2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  3. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.7 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
  1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.
- C. Maintain equal louver blade spacing to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
  1. Frame Type: Channel unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
  1. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades, so louver blades appear continuous. Where length of louver exceeds fabrication

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- and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
- 2. Exterior Corners: Prefabricated corner units with mitered blades with concealed close-fitting splices and with semirecessed mullions at corners.
- G. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Coordinate finish selection with finish selections of Section 084113 "Aluminum-Framed Entrances and Storefronts," and Section 085450 "Composite Windows."
- C. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.
  - 2. Coordinate finish color selection with color selections in Section 084113 "Aluminum-Framed Entrances and Storefronts," and Section 085450 "Composite Windows."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

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- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes gypsum board shaft wall assemblies.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each component of gypsum board shaft wall assembly.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
- B. Do not install finish panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated.
- B. STC Rating: As indicated.
- C. Gypsum Shaftliner Board:
  - 1. Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) CertainTeed Corporation; ProRoc Shaftliner.
      - 2) Continental Building Products, LLC; Shaftliner Type X.
      - 3) Georgia-Pacific Building Products; ToughRock Fireguard Shaftliner.
      - 4) National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
      - 5) PABCO Gypsum; Pabcore Shaftliner Type X.
      - 6) USG Corporation; Sheetrock Brand Gypsum Liner Panel.
  - 2. Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch thick, and with double beveled long edges.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) CertainTeed Corporation; ProRoc Moisture and Mold Resistant Shaftliner.
      - 2) Continental Building Products, LLC; Mold Defense Shaftliner Type X.
      - 3) Georgia-Pacific Building Products; Dens-Glass Ultra Shaftliner.
      - 4) National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.
      - 5) PABCO Gypsum; Pabcore Mold Curb Shaftliner Type X.
      - 6) USG Corporation; Sheetrock Brand Mold Tough Gypsum Liner Panel.
- D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.



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1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 unless otherwise indicated.
  - E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
    1. Depth: As indicated.
    2. Minimum Base-Metal Thickness: As indicated.
  - F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
    1. Minimum Base-Metal Thickness: Matching steel studs.
  - G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    1. Products: Subject to compliance with requirements, provide one of the following:
      - a. BlazeFrame Industries; Shaftwall Intumescent Framing/Fire Stop System.
      - b. Fire Trak Corp; Fire Track System.
      - c. GCP Applied Technologies Inc. (formerly Grace Construction Products); FlameSafe FlowTrak System.
      - d. Metal-Lite; The System.
      - e. Steel Network, Inc. (The); VertiTrack VTD.
  - H. Finish Panels: Gypsum board as specified in Section 092900 "Gypsum Board."
  - I. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."
- 2.3 AUXILIARY MATERIALS
- A. General: Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
  - B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
  - C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
  - D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
    1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.

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2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).
- F. Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."
- G. Gypsum Board Cants:
1. Gypsum Board Panels: As specified in Section 092900 "Gypsum Board," Type X, 5/8-inch panels.
  2. Non-Load-Bearing Steel Framing: As specified in Section 092216 "Non-Structural Metal Framing."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
  1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
  2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection

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behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Gypsum Board Cants: At projections into shaft exceeding 4 inches, install gypsum board cants covering tops of projections.
  - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
  - 2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.
- J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.3 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Certificates: For each type of code-compliance certification for studs and tracks.
- C. Evaluation Reports: For embossed steel studs and tracks, firestop tracks, post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

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1.5 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C 645. Use either steel studs and tracks or embossed steel studs and tracks.
  - 1. Steel Studs and Tracks:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) CEMCO; California Expanded Metal Products Co.
      - 2) Custom Stud.
      - 3) MarinoWARE.
      - 4) MBA Building Supplies.
      - 5) MRI Steel Framing, LLC.
      - 6) Phillips Manufacturing Co.
      - 7) SCAFCO Steel Stud Company.
      - 8) Steel Network, Inc. (The).
      - 9) Telling Industries.

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- b. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection.
  - c. Depth: As indicated on Drawings.
- 2. Embossed Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally equivalent to conventional ASTM C 645 steel studs and tracks.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) CEMCO; California Expanded Metal Products Co.
    - 2) ClarkDietrich Building Systems.
    - 3) MarinoWARE.
    - 4) MBA Building Supplies.
    - 5) Phillips Manufacturing Co.
    - 6) SCAFCO Steel Stud Company.
    - 7) Steel Network, Inc. (The).
    - 8) Telling Industries.
  - b. Minimum Base-Metal Thickness: As required by horizontal deflection performance requirements.
  - c. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
  - 1. Single Long-Leg Track System: ASTM C 645 top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  - 2. Double-Track System: ASTM C 645 top outer tracks, inside track with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
  - 3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Blazeframe Industries; Bare Slotted Track (BST/BST 2).
      - 2) CEMCO; California Expanded Metal Products Co.; SLP-TRK Slotted Deflection Track.
      - 3) ClarkDietrich Building Systems; MaxTrak Slotted Deflection Track.
      - 4) MBA Building Supplies; Slotted Deflecto Track.
      - 5) Metal-Lite; The System.
      - 6) Perfect Wall, Inc.; The System Slotted Deflection Track.
      - 7) SCAFCO Steel Stud Company; SCAFCO Slotted Leg Track System.
      - 8) Steel Network, Inc. (The); VertiTrack VTD.
      - 9) Telling Industries; Vertical Slip Track II.

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- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Blazeframe Industries; Intumescent Framing, Fire Stop System.
    - b. CEMCO; California Expanded Metal Products Co.; FAS Track.
    - c. ClarkDietrich Building Systems; BlazeFrame.
    - d. Fire Trak Corp; Fire Trak System attached to studs with Fire Trak Posi Klip.
    - e. Metal-Lite; The System.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ClarkDietrich Building Systems.
    - b. MarinoWARE.
    - c. MRI Steel Framing, LLC.
    - d. SCAFCO Steel Stud Company.
  2. Minimum Base-Metal Thickness: 0.0296 inch.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ClarkDietrich Building Systems.
    - b. MarinoWARE.
    - c. MRI Steel Framing, LLC.
    - d. SCAFCO Steel Stud Company.
  2. Depth: As indicated on Drawings.
  3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ClarkDietrich Building Systems.
    - b. MarinoWARE.
    - c. MRI Steel Framing, LLC.
    - d. SCAFCO Steel Stud Company.
  2. Minimum Base-Metal Thickness: 0.0179 inch.

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3. Depth: As indicated on Drawings.
- H. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ClarkDietrich Building Systems.
    - b. MarinoWARE.
    - c. MRI Steel Framing, LLC.
    - d. SCAFCO Steel Stud Company.
  2. Configuration: Hat shaped.
- I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: As indicated on Drawings.
  2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
  3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ClarkDietrich Building Systems.
    - b. MarinoWARE.
    - c. MRI Steel Framing, LLC.
    - d. SCAFCO Steel Stud Company.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 as appropriate for the substrate.
    - a. Uses: Securing hangers to structure.
    - b. Type: Torque-controlled, adhesive anchor.



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- c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
  - d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
  - 1. Depth: As indicated on Drawings.
- E. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
  - 2. Steel Studs and Tracks: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.0179 inch.
    - b. Depth: As indicated on Drawings.
  - 3. Embossed Steel Studs and Tracks: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.0147 inch.
    - b. Depth: As indicated on Drawings.
  - 4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base-Metal Thickness: 0.0179 inch.
  - 5. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
    - a. Configuration: Hat shaped.
  - 6. Resilient Sound Isolation Clip: ASTM D 2000.
    - a. Minimum Base-Metal Thickness: 0.040 inch.
    - b. Depth: As indicated on Drawings. Projects 1-5/8 inches from supporting structure, when 7/8-inch drywall furring channels are use.
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc; Drywall Grid Systems.
    - b. Chicago Metallic Corporation; 640/660 Drywall Ceiling Suspension or 650/670 Fire Rated Drywall Ceiling Suspension.

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- c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.

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- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
  - 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
  - 3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:
  - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Z-Shaped Furring Members:
  - 1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.

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2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
  3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches o.c.
  2. Carrying Channels (Main Runners): 48 inches o.c.
  3. Furring Channels (Furring Members): 16 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  4. Do not attach hangers to steel roof deck.
  5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

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- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.
- B. Related Requirements:
  - 1. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Samples: For the following products:
  - 1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.
- D. Samples for Initial Selection: For each type of trim accessory indicated.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Build mockups for the following:
    - a. Each level of gypsum board finish indicated for use in exposed locations
  - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
  - 3. Simulate finished lighting conditions for review of mockups.

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4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Ceiling and wall materials shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

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2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Gypsum.
  - b. CertainTeed Corporation.
  - c. Continental Building Products, LLC.
  - d. Georgia-Pacific Building Products.
  - e. National Gypsum Company.
  - f. PABCO Gypsum.
  - g. Temple-Inland Building Products by Georgia-Pacific.
  - h. USG Corporation.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Gypsum.
  - b. CertainTeed Corporation.
  - c. Continental Building Products, LLC.
  - d. Georgia-Pacific Building Products.
  - e. National Gypsum Company.
  - f. PABCO Gypsum.
  - g. Temple-Inland Building Products by Georgia-Pacific.
  - h. USG Corporation.
2. Core: 5/8 inch, Type X.
3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

C. Impact-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Gypsum.
  - b. CertainTeed Corporation.
  - c. Continental Building Products, LLC.
  - d. Georgia-Pacific Building Products.
  - e. National Gypsum Company.



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- f. [PABCO Gypsum.](#)
    - g. [Temple-Inland Building Products by Georgia-Pacific.](#)
    - h. [USG Corporation.](#)
  - 2. Core: 5/8 inch, Type X.
  - 3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
  - 4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
  - 5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
  - 6. Hard-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements according to test in Annex A1.
  - 7. Long Edges: Tapered.
  - 8. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- D. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
- 1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
    - a. [American Gypsum.](#)
    - b. [CertainTeed Corporation.](#)
    - c. [Continental Building Products, LLC.](#)
    - d. [Georgia-Pacific Building Products.](#)
    - e. [National Gypsum Company.](#)
    - f. [PABCO Gypsum.](#)
    - g. [Temple-Inland Building Products by Georgia-Pacific.](#)
    - h. [USG Corporation.](#)
  - 2. Core: 5/8 inch, Type X.
  - 3. Long Edges: Tapered.
  - 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C1396/C1396M. Manufactured to have increased fire-resistive capability.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. Certainteed; SAINT-GOBAIN.
    - c. Continental Building Products Inc.
    - d. Georgia-Pacific Gypsum LLC.
    - e. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - f. PABCO Gypsum.
    - g. Panel Rey.
    - h. USG Corporation.
  - 2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
  - 3. Long Edges: Tapered.

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2.5 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Georgia-Pacific Building Products.
    - c. National Gypsum Company.
    - d. Temple-Inland Building Products by Georgia-Pacific.
    - e. USG Corporation.
  2. Core: 5/8 inch, Type X.
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the the following:
    - a. C-Cure.
    - b. CertainTeed Corporation.
    - c. Custom Building Products.
    - d. FinPan, Inc.
    - e. James Hardie Building Products, Inc.
    - f. National Gypsum Company.
    - g. USG Corporation.
  2. Thickness: 5/8 inch.
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
  2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - d. L-Bead: L-shaped; exposed long flange receives joint compound.
    - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
    - g. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fry Reglet Corporation.
  - b. Gordon, Inc.
  - c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

## 2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  1. Interior Gypsum Board: Paper.
  2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  4. Finish Coat: For third coat, use drying-type, all-purpose compound.
  5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- D. Joint Compound for Tile Backing Panels:
  1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
  2. Cementitious Backer Units: As recommended by backer unit manufacturer.

## 2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

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1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Accumetric LLC.
    - b. Franklin International.
    - c. Grabber Construction Products.
    - d. Hilti, Inc.
    - e. Pecora Corporation.
    - f. Specified Technologies, Inc.
    - g. USG Corporation.
  2. Sealant shall have a VOC content of 250 g/L or less.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.

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- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X: Vertical surfaces unless otherwise indicated.
  - 2. Abuse-Resistant Type: As indicated on Drawings.
  - 3. Impact-Resistant Type: As indicated on Drawings.
  - 4. Mold-Resistant Type: As indicated on Drawings.
  - 5. Type C: Where required for fire-rated floor and roof assemblies.
- B. Single-Layer Application:

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1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
  - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
  - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

### 3.4 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Cementitious Backer Units: ANSI A108.11, at showers indicated to receive tile.
- C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:

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1. Cornerbead: Use at outside corners unless otherwise indicated.
2. Bullnose Bead: Use where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use at exposed panel edges.

- D. Aluminum Trim: Install in locations indicated on Drawings.

### 3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
  3. Level 5: Where indicated on Drawings.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

### 3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

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2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION



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SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Glazed wall tile.
2. Porcelain tile.
3. Metal edge strips.
4. Uncoupling membrane.
5. Expansion joints.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 092900 "Gypsum Board" for cementitious backer units or glass-mat, water resistant backer board.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.
- E. Large Format Tile: Tile with at least one edge 15 inches or longer.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

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1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Shop Drawings: Show locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- D. Sustainable Design Submittals:
  1. Environmental Product Declaration: For each product.
  2. Health Product Declaration: For each product.
  3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
  4. Health Product Declaration: For each product.
  5. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
  6. Product Data: For adhesives, indicating VOC content.
  7. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For Installer.
- C. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- D. Product Certificates: For each type of product.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Tile: Furnish one box for each type, composition, color, pattern, and size indicated.

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1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Qualified Installer who employs workers for this project who are competent in techniques required by manufacturer for tile installation indicated.

1.9 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.11 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

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- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
  - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
  - 1. Metal edge strips, thresholds and control joints.
  - 2. Waterproofing/uncoupling membrane.

## 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

## 2.3 TILE PRODUCTS

- A. Ceramic Tile Type: Glazed wall tile (CWT-1).
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Handwritten by Crossville, or comparable product by one of the following:
    - a. American Olean; a division of Dal-Tile Corporation.
    - b. Mosa Tile.
  - 2. Face Size: 3 inches by 12 inches.
  - 3. Face Size Variation: Rectified.
  - 4. Thickness: 3/8 inch.
  - 5. Face: Smooth.
  - 6. Tile Color, Glaze, and Pattern: As selected by Architect from manufacturer's full range.
  - 7. Grout Color: As selected by Architect from manufacturer's full range.
- B. Ceramic Tile Type: Glazed wall tile (CWT-2).
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Kit-Kats by Platform/Surfaces, or comparable product by one of the following:

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- a. Daltile; a brand of Dal-Tile Corporation.
  - b. Mosa Tile.
2. Face Size: 4.5 inches by 9 inches.
  3. Face Size Variation: Rectified.
  4. Thickness: 3/8 inch.
  5. Face: Pre-scored/glossy.
  6. Tile Color, Glaze, and Pattern: As selected by Architect from manufacturer's full range.
  7. Grout Color: As selected by Architect from manufacturer's full range.

2.4 PORCELAIN TILE (PT 1-2)

A. Porcelain Tile Type:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Owen Stone by Crossville, or comparable product by one of the following:
  - a. American Olean; a division of Dal-Tile Corporation.
  - b. DalTile.
  - c. Mosa Tile.
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 24 inches by 48 inches (PT-1).
4. Face Size: 12 inches by 24 inches (PT-2).
5. Face Size Variation: Rectified.
6. Thickness: 10.5 mm (PT-1).
7. Thickness: 9.5 mm (PT-2).
8. Tile Color, Glaze, and Pattern: As selected by Architect from manufacturer's full range.
9. Grout Color: As selected by Architect from manufacturer's full range.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
  - a. Base: Bullnose, module size 4x24.

2.5 UNCOUPLING MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Crack Isolation Membrane, Polyethylene Sheet: Polyethylene faced on both sides with polyester fleece fabric.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Ditra XL by Schluter Systems or comparable product by one of the following:
    - a. UI 740 Flexbone by Ardex.
    - b. RedGard Uncoupling Mat by Custom Building Products.
    - c. Strata Mat by Laticrete.

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- d. Mapeguard UM MAPEI Corporation.

## 2.6 SETTING MATERIALS

- A. Modified Dry-Set Mortar (Thinset): ANSI A118.4T, A18.11, A118.15T (PT-1 and 2).

- 1. Manufacturers: Subject to compliance with requirements, provide ALL-SET by Schluter, or comparable product for large format tile by one of the following:
  - a. ARDEX Americas.
  - b. LATICRETE SUPERCAP, LLC.
  - c. MAPEI Corporation.
- 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
- 3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- 4. Coordinate mortar with waterproof/uncoupling membrane.

- B. Standard Dry-Set Mortar (Thinset): ANSI A118.1 (for CWT-1 and CWT-2).

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ARDEX Americas.
  - b. Bostik; Arkema.
  - c. Custom Building Products.
  - d. Laticrete International, Inc.
  - e. MAPEI Corporation.
- 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.1.

## 2.7 GROUT MATERIALS

- A. Grout: High-performance tile grout, ANSI A118.3 and A118.6.

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide “Flexcolor CQ Unsanded,” Mapei Corp., or comparable product by one of the following:
  - a. Bostik, Inc.
  - b. C-Cure.
  - c. Custom Building Products.
  - d. H.B. Fuller Construction Products Inc. / TEC.
  - e. LATICRETE SUPERCAP, LLC.
  - f. Merkrete by Parex USA, Inc.
  - g. Summitville Tiles, Inc.

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2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips at Outside Corners, Base and Caps: Trapezoid-perforated anchoring leg providing a decorative finish and protecting adjacent tiles in brushed nickel.
  - 1. Basis-of-Design Product: Schluter's "Jolly" with matching trim profiles.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- D. Movement Joint: Schluter-DILEX-KSN.

2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Fill cracks, holes, and depressions in substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    - a. Tile floors in wet areas.
    - b. Tile floors consisting of tiles 8 by 8 inches or larger.
    - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - 1. Glazed Wall Tile: 1/16 inch.
  - 2. Porcelain Tile: 1/8 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.



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- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Metal Edge Strips: Install at locations where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with tile. Install at outside corners of wall tile and at base and top of finished tile.

### 3.4 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  - 1. Remove grout residue from tile as soon as possible.
  - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

### 3.5 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls.
- B. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

### 3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Metal Studs or Furring:
  - 1. Ceramic Tile Installation: TCNA W243; thinset mortar on moisture-resistant gypsum board.
    - a. Ceramic Tile Type: Glazed wall tile (CWT-1 and CWT-2).
    - b. Thinset Mortar: Standard dry set mortar.
    - c. Grout: High-performance ready to use quartz aggregate grout.
- B. Interior Radiant Heat Floor Installations, Concrete Subfloor:

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1. TCNA RH110: Thinset mortar on crack isolation membrane; hydronic piping installed in concrete.
  - a. Ceramic Tile Type: PP-1 and PP-2.
  - b. Thinset Mortar: Modified dry-set.
  - c. Grout: High-performance ready to use quartz aggregate grout.
  - d. Crack Isolation Membrane: Polyethylene sheet.
  - e. Joint Width: 1/8-inch.
  - f. Movement Joints: Types located on Drawings.

END OF SECTION

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SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. For each type of product.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating percentage of postconsumer and pre-consumer recycled content and cost.
2. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and pre-consumer recycled content.
3. Environmental Product Declaration (EPD): For each product.
4. Health Product Declaration (HPD): For each product.
5. Laboratory Test Reports: For ceiling products, indicating compliance with the VOC emissions evaluation.

1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

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- a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
- 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
- 5. Size and location of initial access modules for acoustical panels.
- 6. Items penetrating finished ceiling and ceiling-mounted items including the following:
  - a. Lighting fixtures.
  - b. Diffusers.
  - c. Grilles.
  - d. Speakers.
  - e. Sprinklers.
  - f. Access panels.
  - g. Perimeter moldings.
- 7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
- 8. Minimum Drawing Scale: 1/8 inch = 1 foot.
- C. Qualification Data: For testing agency.
- D. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.
- E. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For finishes to include in maintenance manuals.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Units: Full-size panels equal to 2 boxes of each type installed.
  - 2. Suspension-System Components: Quantity of each exposed component equal to 2 boxes of each type installed.

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1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical ceiling area as indicated on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations for Ceiling System: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Verify ceiling products comply with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Seismic Performance: Suspended ceilings to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

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1. Flame-Spread Index: Class A in accordance with ASTM E1264.
  2. Smoke-Developed Index: 50 or less.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL or from the listings of another qualified testing agency.

## 2.3 ACOUSTICAL PANELS

### A. Acoustical Panels :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Calla, or comparable product by one of the following:
  - a. CertainTeed; SAINT-GOBAIN
  - b. USG Corporation
2. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
3. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 75 percent.
4. Classification: Provide fire-resistance-rated panels as follows:
  - a. Type A, Form 2.2, Pattern G; Fire Class A mineral base with acoustically transparent membrane.
  - b. Pattern: G (smooth).
5. Color: White.
6. Light Reflectance (LR): Not less than 0.85.
7. Ceiling Attenuation Class (CAC): Not less than 35.
8. Noise Reduction Coefficient (NRC): Not less than 0.85.
9. Articulation Class (AC): Not less than 170.
10. Edge/Joint Detail: Square.
11. Thickness: 1 inch.
12. Modular Size: 24 by 24 inches.
13. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

## 2.4 METAL SUSPENSION SYSTEM

### A. Exposed Metal Suspension System :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Suprafine, or comparable product by one of the following:

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- a. CertainTeed; SAINT-GOBAIN
  - b. USG Corporation
2. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.
3. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 9/16-inch-wide metal caps on flanges.
  - a. Structural Classification: Intermediate-duty system.
  - b. End Condition of Cross Runners: Override (stepped) or butt-edge type.
  - c. Face Design: Flat, flush.
  - d. Cap Material: Cold-rolled steel.
  - e. Cap Finish: Painted white.

## 2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
  1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing in accordance with ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: Cast-in-place anchors.
  2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing in accordance with ASTM E1190, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
  1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
  2. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
  3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch-diameter wire.

## 2.6 METAL EDGE MOLDINGS AND TRIM

- A. Metal Edge Moldings and Trim:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong Ceiling & Wall Solutions
  - b. CertainTeed; SAINT-GOBAIN
  - c. USG Corporation
2. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
  - a. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
  - b. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
  - c. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.



### 3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

- A. Install acoustical panel ceilings in accordance with ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
  - 1. Fire-Rated Assembly: Install fire-rated ceiling systems in accordance with tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  - 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 7. Do not attach hangers to steel deck tabs.
  - 8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  - 9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
  - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

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- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
  - 1. Arrange directionally patterned acoustical panels as follows:
    - a. Install panels with pattern running in one direction parallel to long axis of space.
  - 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  - 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 095426 – SUSPENDED WOOD CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood, linear-panel ceilings.
2. Exposed grid suspension system.
3. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.

B. Related Requirements:

1. Section 095113, “Acoustical Panel Ceilings.”
2. Section 265119, “LED Interior Lighting.”

1.2 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

1.3 COORDINATION

- A. Coordinate layout and installation of wood ceilings and suspension systems with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
1. Product Data: Verify compliance with requirements for Forest Stewardship Council U.S. (FSC).
  2. Chain-of-Custody Qualification Data: For manufacturer and vendor.
  3. Product Data: For adhesives, indicating VOC content.
  4. Environmental Product Declaration (EPD): For each product.
  5. Health Product Declaration (HPD): For each product.

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D. Shop Drawings: For suspended wood ceilings.

1. Include reflected ceiling plans, sections, and details, drawn to scale, showing the following:
  - a. Wood ceiling patterns and joints.
  - b. Ceiling suspension members.
  - c. Method of attaching hangers to building structure and locations of cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
  - d. Ceiling-mounted items including, but not limited to, light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
  - e. Ceiling perimeter and penetrations through ceiling; trim and moldings.

E. Samples for Verification: For the following products:

1. Wood Ceilings: 12-inch-long by 12-inch-wide or full-width Samples of each type, color, and finish.
2. Suspension-System Members: 12-inch-long Sample of each type.
3. Exposed Molding and Trim: 12-inch-long Samples of each type, color, and finish.
4. Veneer Edge Banding: Applied to a cut end of a wood-ceiling Sample for each type, color, and finish.
5. Filler Strips: 12-inch-long Samples of each type, color, and finish.
6. Sound Absorbers: 12 inches long by full width.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Wood ceiling patterns and joints.
  2. Suspended ceiling components above ceiling units.
  3. Structural members to which suspension devices will be attached.
  4. Items penetrating or covered by units including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Alarms.
    - e. Sprinklers.
  5. Show operation of hinged and sliding components covered by or adjacent to units.
- C. Qualification Data: For testing agency.
- D. Product Test Reports: For each suspended wood ceiling, for tests performed by a qualified testing agency.

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- E. Evaluation Reports: For suspended-wood-ceiling framing systems.
- F. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For finishes to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Suspended-Wood-Ceiling Components: Quantity of each wood-ceiling unit, suspension-system component, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

1.9 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Build mockup of each type of suspended wood ceiling as shown on Drawings.
    - a. Demonstrate treatment of exposed field cuts.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ceiling components and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
  - 1. Store materials flat and level, raised from the floor.
- B. Handle ceiling components and accessories in a manner that prevents damage.

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1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install interior ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
  - 1. Store and acclimatize wood products in the spaces where they will be installed for a minimum of 72 hours immediately before ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Ceilings shall maintain the quality as instituted by the Architect and AWI.
- B. Wood shall be kiln dried to 10 percent. Cracking, checking, and warpage of members will not be acceptable.

2.2 WOOD, LINEAR-PANEL CEILINGS (WD)

- A. Solid-Wood, Linear-Panel Ceilings : Linear panels fabricated from kiln-dried solid-wood planks free of knots and without finger joints, cracks, checks, or warp. Planks run parallel to panel length.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong's "Wood Works" Linear Solid Wood Panel System, or comparable product by one of the following:
    - a. 9Wood
    - b. ASI Architectural
    - c. Rulon
  - 2. Plank:
    - a. Species: Poplar.
    - b. Cut: Manufacturer's standard.
    - c. Width: 5-1/4 inches.
    - d. Depth: 3/4 inch.
    - e. Length: 96 inches.
    - f. Edges: Square.
    - g. Reveal Spacing: Equal spacing between long edges of planks.
    - h. Backing Boards: Manufacturer's standard, 1/2-inch- thick.
      - 1) Backing Board Gloss and Color: Flat black.
  - 3. Panel Module: 12 by 96 by 1-1/4 inches.

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- a. Attachment: Provide manufacturer's standard metal spring clips for attaching panels to grid suspension system, spaced to support ceiling and in accordance with manufacturer's written installation instructions.
- 4. Factory Finish: Manufacturer's standard interior finish; applied on every wood surface.
  - a. Surface-Burning Characteristics: Provide manufacturer's standard finish system with the following characteristics when tested in accordance with ASTM E84:
    - 1) Flame-Spread Index: 200 or less.
    - 2) Smoke-Developed Index: 450 or less.
  - b. Finish: Clear.
  - c. Stain: As selected by Architect from manufacturer's standard range.
  - d. Gloss: Semigloss.
- 5. Accessories: Manufacturer's accessories required to provide a complete installation of ceiling in accordance with manufacturer's written installation instructions.
  - a. Acoustic Infill Panels: 1-inch-thick glass fiber, 1 lb/cu. ft. density, enclosed in black polyethylene, with flame-spread index of 25 or less and smoke-developed index of 50 or less as determined by testing in accordance with ASTM E84.
    - 1) NRC: 0.80 when tested in accordance with ASTM C423.
  - b. Acoustic Felt: Manufacturer's standard, factory applied, black, backer with flame-spread index of 25 or less and smoke-developed index of 450 or less as determined by testing in accordance with ASTM E84.
  - c. End Caps: Manufacturer's standard units for exposed field-cut edges; solid wood finished to match planks.
  - d. Trim: Manufacturer's standard solid wood finished to match planks; with trim connectors recommended in writing by ceiling and suspension-system manufacturers.
- 6. Grid Suspension System: ASTM C635/C635M; recommended in writing by ceiling and suspension-system manufacturers for applications indicated; main- and cross-runner system complete with suspension-system components required to support ceiling units and other ceiling-supported construction.
  - a. Material: ASTM A653/A653M, hot-dip galvanized, cold-rolled sheet steel, G60 coating designation.
  - b. Structural Classification: Heavy-duty system.
  - c. Face Width: 15/16 inch.
  - d. Finish: Flat black.

2.3 SUSPENSION-SYSTEM HANGERS, BRACES, AND TIES

- A. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.
  - 1. Cast-in-Place and Postinstalled Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capabil-

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ity to sustain, without failure, a load equal to 5 times that imposed by ceiling construction as determined by testing in accordance with ASTM E488/E488M or ASTM E1512, as applicable, conducted by a qualified testing and inspecting agency.

- a. Type: Cast-in-place anchors.
- b. Corrosion Protection:

- 1) Carbon-steel components zinc plated to comply with ASTM B633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).

- 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction as determined by testing in accordance with ASTM E1190 conducted by a qualified testing and inspecting agency.

- B. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:

- 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
  - 2. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung is less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which suspended wood ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and with requirements for installation tolerances and other conditions affecting performance of suspended wood ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of suspended wood ceilings.
  - 1. Balance border widths at opposite edges of each ceiling.
  - 2. Avoid using less-than-half-width units.
  - 3. Ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).



### 3.3 INSTALLATION OF SUSPENDED WOOD CEILINGS

- A. Comply with ASTM C636/C636M and seismic requirement indicated, in accordance with manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns in 3 inches. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
  - 5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 6. Do not attach hangers to steel deck tabs.
  - 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  - 8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  - 9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Install edge moldings and trim at perimeter of ceiling area and where necessary to conceal edges and ends of wood units.
  - 1. Screw-attach metal moldings to substrate at intervals of not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 ft.. Miter corners accurately and connect securely.
  - 2. Do not use exposed fasteners on moldings and trim.
- D. Grid Suspension Systems: Space main beams at 48 inches o.c.
  - 1. Install cross tees to form modules sized in accordance with manufacturer's written installation instructions.
  - 2. Remove and replace dented, bent, or kinked members.
- E. Linear-Carrier Suspension Systems: Install carriers at no more than 24 inches o.c. aligned and securely interlocked with one another.
  - 1. Install stabilizer channels, tees, and bars at regular intervals to stabilize carriers and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated.
  - 2. Remove and replace dented, bent, or kinked members.

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- F. Install wood components and accessories in accordance with manufacturer's written instructions and to accommodate natural expansion and contraction of wood products resulting from fluctuations in humidity.
- G. Cut wood components for accurate fit at borders and at interruptions and penetrations by other work through ceilings.
  - 1. Stiffen edges of cut wood components as required to eliminate variations in flatness.
- H. Treat field-cut edges of wood components in accordance with manufacturer's written recommendations; finish exposed field cuts to match factory finish.
  - 1. Solid-Wood Planks: Use solid-wood end caps to conceal exposed field-cut edges.
- I. Install wood components in coordination with suspension system and moldings and trim.
  - 1. Install wood components in patterns indicated on Drawings.
- J. Install field-constructed access panels in locations indicated on Drawings.

3.4 CLEANING

- A. Clean exposed surfaces of ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented units.

END OF SECTION

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SECTION 096340 – EXTERIOR STONE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Dimension stone exterior paving and steps.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 010000 "General Requirements" and the individual sections specifying the work.
- B. Product Data: For each variety of stone, stone accessory, and manufactured product.
- C. Sustainable Design Submittals:
  - 1. Regional Materials.
- D. Shop Drawings: Include plans, sections, details, and attachments to other work.
  - 1. Show locations and details of joints both within stone flooring and between stone flooring and other finish materials.
- E. Samples for Initial Selection:
  - 1. For granite at exterior steps.
  - 2. For joint materials involving color selection.
- F. Samples for Verification:
  - 1. For each stone type indicated, in sets of Samples not less than 12 inches square. Include at least two or more Samples in each set and show the full range of color and other visual characteristics in completed Work.
  - 2. For each color of pointing mortar required.

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1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 010000 "General Requirements" and the individual sections specifying the work.
- B. Material Test Reports:
  - 1. Stone Test Reports: For each stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, according to referenced ASTM standards. Base reports on testing within previous five years.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone flooring.
- B. Installer Qualifications: A firm or individual experienced in installing stone flooring similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
  - 1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
  - 2. Store stone on wood A-frames or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
- B. Mark stone units, on surface that is concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels, so that they are right side up when units are installed.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.7 FIELD CONDITIONS

- A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than 50 deg F during installation and for seven days after completion.
- B. Cold-Weather Requirements for Exterior Stone Flooring: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and

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replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

- C. Hot-Weather Requirements for Stone Flooring: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and with the following:
1. Maintain temperature of materials below 100 deg F.
  2. Do not apply mortar to substrates with temperatures of 100 deg F and above.
  3. When the ambient temperature exceeds 90 deg F, fog spray installed stone flooring until damp at least three times a day until flooring is three days old.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain stone, from single quarry with resources to provide materials of consistent quality in appearance and physical properties.
1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
- B. Stone Fabricators: Subject to compliance with requirements, provide products by one of the following:
1. Exterior Granite Paving at Plaza Areas: Freshwater Stone.
  2. Exterior Granite Steps at Doors E05 and E06: Match existing granite.

### 2.2 GRANITE

- A. Material Standard: Comply with ASTM C615/C615M.
- B. Regional Materials: Fabricate stone within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.
- C. Description: Uniform, medium-grained, gray stone.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
1. Exterior Granite Paving at Plaza Areas: Freshwater Pearl (Freshwater Stone).
  2. Exterior Granite Steps at Doors E05 and E06: Submit at least three options for matching existing granite for Architect's initial selection.
- E. Finish: Thermal.
- F. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

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2.3 MORTAR MATERIALS

- A. Regional Materials: Manufacture aggregate for mortar, cement and lime within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- B. Portland Cement: ASTM C150/C150M, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C150/C150M, Type I or Type III, and hydrated lime complying with ASTM C207, Type S.
  - 1. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Essroc.
    - b. Holcim (US) Inc.
    - c. Lafarge North America Inc.
    - d. Lehigh Hanson; Heidelberg Cement Group.
    - e. Mutal Materials Co.
- E. Aggregate: ASTM C144; except for joints narrower than 1/4 inch and pointing mortar, use aggregate graded with 100 percent passing No. 16 sieve.
  - 1. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.
- F. Water: Potable.

2.4 ACCESSORIES

- A. Temporary Spacers: Resilient plastic, nonstaining to stone, sized to suit joint thickness.
- B. Cork Joint Filler: Preformed strips complying with ASTM D1752, Type II.
- C. Joint Sealants: Manufacturer's standard sealants that comply with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone they are applied to.
  - 1. Colors: Provide colors of exposed sealants to match other joints in stone adjoining sealed joints unless otherwise indicated.
- D. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

## 2.5 MORTAR MIXES

- A. Mortar: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
  - 1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
  - 2. Combine mortar materials and thoroughly mix in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.
  - 3. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding any water. Add only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.
- B. Portland Cement-Lime Setting Mortar: ASTM C270, Proportion Specification, Type S. Use amount of water to produce a stiff mixture with a moist surface when bed is ready to receive stone.
- C. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions and to produce a stiff mixture with a moist surface when bed is ready to receive stone.
- D. Mortar-Bed Bond Coat: Mix neat cement and water to a creamy consistency.
- E. Cement-Paste Bond Coat: Mix either neat cement or cement and sand with water to a consistency similar to that of thick cream.
- F. Pointing Mortar: Comply with requirements indicated above for setting mortar, including type and the following:
  - 1. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with portland cement of selected color.

## 2.6 FABRICATION OF STONE

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
- B. Fabricate stone to comply with requirements indicated and with the following references:
  - 1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
- C. Cut stone to produce pieces of thickness, size, and shape indicated.

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1. Stone Thickness: As indicated.
  2. Pattern: As indicated.
  3. Stone Edges: Square cut with top corner slightly eased to prevent snipping. Provide bullnose edge at steps as indicated on Drawings.
  4. Joint Width: 1/4 inch.
- D. Carefully inspect finished stone units at fabrication plant for compliance with appearance, material, and fabrication requirements. Replace defective units. Clean sawed backs of stones to remove rust stains and iron particles.
1. Grade and select stone for overall uniform appearance when assembled in place.
  2. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved Samples and mockups.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine surfaces to receive stone flooring and conditions under which stone flooring will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone flooring.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone flooring.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.
- B. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
- C. Before setting stone, clean dirty or stained stone surfaces by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

#### 3.3 INSTALLATION, GENERAL

- A. Do necessary field cutting as stone is set. Cut lines straight and true, and finish field-cut edges to match shop-cut edges.
  1. Use power saws with diamond blades to cut stone.



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- B. Set stone to comply with requirements indicated. Match stone for color and pattern by using units numbered in sequence as indicated on Shop Drawings.
- C. Scribe and field cut stone as necessary to fit at obstructions. Produce neat joints of size specified or indicated.
- D. Provide control and expansion joints of widths and at locations indicated. Keep control and expansion joints free of mortar, grout, and other rigid materials.

3.4 INSTALLATION TOLERANCES

- A. Variation in Line: For positions shown in plan for edges of flooring, ramps, steps, changes in color or finish, and continuous joint lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.
- B. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/16 inch or one-fourth of nominal joint width, whichever is less.
- C. Variation in Surface Plane: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch maximum from level or slope indicated.
- D. Variation in Plane between Adjacent Units (Lipping): Do not exceed 1/32-inch difference between planes of adjacent units.

3.5 INSTALLATION OF STONE BONDED TO CONCRETE

- A. Saturate concrete with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Apply mortar-bed bond coat to damp concrete and broom to provide an even coating that completely covers the concrete. Do not exceed 1/16-inch thickness. Limit area of mortar-bed bond coat to avoid its drying out before placing setting bed.
- C. Apply mortar bed immediately after applying mortar-bed bond coat. Spread, tamp, and screed to uniform thickness at elevations required for setting stone to finished elevations indicated.
- D. Mix and place only that amount of mortar bed that can be covered with stone before initial set. Cut back, bevel edge, and discard material that has reached initial set before stone can be placed.
- E. Place stone before initial set of mortar occurs. Immediately before placing stone on setting bed, apply uniform 1/16-inch-thick bond coat to mortar bed or to back of each stone unit.
- F. Tamp and beat stone with a wooden block or rubber mallet to obtain full contact with mortar bed and to bring finished surfaces within indicated tolerances. Set each unit in a single operation before initial set of mortar; do not return to areas already set and disturb stone for purposes of realigning finished surfaces or adjusting joints.

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- G. Rake out joints to depth required to receive pointing mortar as units are set.
- H. Point joints after setting. Fill full with mortar type and color indicated. Tool joints flat, uniform, and smooth, without visible voids.

3.6 INSTALLATION OF JOINT-SEALANT

- A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 321373 "Concrete Paving Joint Sealants."

3.7 ADJUSTING AND CLEANING

- A. Remove and replace stonework of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
  - 2. Defective joints.
  - 3. Stone flooring and joints not matching approved Samples and mockups.
  - 4. Stonework not complying with other requirements indicated.
- B. Replace in a manner that results in stonework matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean stonework as work progresses. Remove mortar fins and smears before tooling joints.
- D. Clean stonework after setting and pointing are complete. Use procedures recommended by stone fabricator for application types.

3.8 PROTECTION

- A. Prohibit traffic from installed stone for a minimum of 72 hours.
- B. Protect installed stonework during construction with nonstaining kraft paper. Where adjoining areas require construction work access, cover stonework with a minimum of 3/4-inch untreated plywood over nonstaining kraft paper.

END OF SECTION

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Thermoset-rubber base.
  - 2. Rubber stair accessories.
  - 3. Rubber molding accessories.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
  - 3. Product Data: For sealants, indicating VOC content.
  - 4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
  - 5. Laboratory Test Reports: For resilient base and stair products and accessories, indicating compliance with requirements for low-emitting materials.
  - 6. Environmental Product Declaration: For each product.
  - 7. Health Product Declaration: For each product.
  - 8. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

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- B. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Mockups of Stair Treads: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups in this Section with mockups specified in other Sections.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 60 deg F or more than 85 deg F.

1.7 FIELD CONDITIONS

- A. Maintain relative humidity between 35 percent and 65 percent and ambient temperatures within range recommended by manufacturer, but not less than 60 deg F or more than 85 deg F, in spaces to receive resilient products during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 60 deg F or more than 85 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

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2.2 THERMOSET-RUBBER BASE RB-1

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Flexco Corporation.
  - 2. Johnsonite; a Tarkett company.
  - 3. Roppe Corporation; Roppe Holding Company.
- B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
  - 1. Style and Location:
    - a. Style A, Straight: Provide in areas with carpet.
    - b. Style B, Cove: Provide in areas with resilient floor coverings.
- C. Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: As selected from manufacturer's full range.

2.3 RUBBER STAIR ACCESSORIES ST-1

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide ReNew Stair Treads and landing tile by Roppe, or comparable product by one of the following:
  - 1. Burke/Mannington.
  - 2. Flexco Corporation.
  - 3. Johnsonite; a Tarkett company.
  - 4. Nora by Interface.
- C. Stair Treads: ASTM F2169.
  - 1. Type: TS (rubber, vulcanized thermoset) infused with cork.
  - 2. Class: 2, textured with ribbed rubber safety inserts.
  - 3. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
  - 4. Nosing Height: 1-1/2 inches.
  - 5. Thickness: 1/4 inch and tapered to back edge.

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6. Size: Lengths and depths to fit each stair tread in one piece.
  7. Integral Risers: Smooth, flat; in height that fully covers substrate.
- D. Stringers: Height and length after cutting to fit risers and treads and to cover stair stringers, produced by same manufacturer as treads, and recommended by manufacturer for installation with treads.
1. Thickness: Manufacturer's standard.
- E. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
1. Size: 19-11/16 inches by 19-11/16 inches.
- F. Locations: Provide rubber stair accessories in areas indicated on drawings.
- G. Colors and Patterns: R123 Charcoal.

#### 2.4 RUBBER MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Johnsonite/Tarkett.
  2. Roppe Corporation; Roppe Holding Company.
  3. VPI Corporation.
- B. Description: Rubber carpet edge for glue-down applications, reducer strip for resilient floor covering, joiner for tile and carpet transition strips.
1. Johnsonite ME001 LVT to carpet transitions for areas where CPTT meet LVT.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide rubber molding accessories in areas indicated on drawings.
- E. Colors and Patterns: As selected from manufacturer's full range.

#### 2.5 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
1. Verify adhesives have a VOC content of 50 or less.

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- C. Stair-Tread Nose Filler: When recommended by manufacturer, two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Stair Cove Fillet Strip: Provide manufacturer's standard 167 strip where tread and riser meet using 1-inch TP-620 tread tape to secure.
- E. Metal Edge Strips: Extruded aluminum with mill finish, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.
- F. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 7 or more than 11 pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

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- a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
  - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 90 percent relative humidity level measurement.
5. Adhesive Bond Test: An adhesive bond test must be performed using actual stair tread and adhesive materials being installed to determine adequacy. Test areas should be a minimum of 36 inches and remain in place for at least 72 hours prior to evaluation for bond strength to the substrate.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until materials are the same temperature as space where they are to be installed.
  1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
  1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches in length.
    - a. Form without producing discoloration (whitening) at bends.
  2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.



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- a. Miter corners to minimize open joints.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - 2. Tightly adhere to substrates throughout length of each piece.
  - 3. Cove Filler Strip: Install prior to installing one piece tread riser combination using manufacturer's recommended adhesive.
  - 4. Apply floor finish recommended by manufacturer.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum horizontal surfaces thoroughly.
  - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

## SECTION 096519 - RESILIENT TILE FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Solid vinyl floor tile.
- B. Related Requirements:
  - 1. Section 096513 “Resilient Base Accessories” for rubber stair treads and landings.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
  - 3. Environmental Product Declaration: For each product.
  - 4. Health Product Declaration: For each product.
  - 5. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
- D. Shop Drawings: For each type of resilient floor tile.
  - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For Installer.

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1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

- A. Maintain relative humidity between 40 percent and 65 percent and ambient temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 85 deg F, in spaces to receive floor tile during the following periods:
  - 1. 48 to 72 hours before installation.
  - 2. During installation.
  - 3. 48 to 72 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 85 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.

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- E. Install floor tile after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

### 2.2 SOLID VINYL FLOOR TILE (LVT)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Level Set Textured Woodgrains by Interface or comparable product by one of the following:
  - 1. Altro.
  - 2. Johnsonite; A Tarkett Company.
  - 3. Shaw Industries Group, Inc.; Berkshire Hathaway Company.
- B. Tile Standard: ASTM F1700.
  - 1. Class: Class III, Printed Film Vinyl Tile.
  - 2. Type: B, Embossed Surface.
- C. Thickness: 0.18 inch.
- D. Size: 9.845 inch by 39.38 inch.
- E. Wear Layer: 22 mil.
- F. Colors and Patterns: As selected from manufacturer's full range.
- G. Finish: Ceramor.
- H. Installation Method: Ashlar.

### 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

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- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
  - 1. Verify adhesives have a VOC content of 50 or less.
  - 2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 7 or more than 9 pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 6 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 90 percent relative humidity level measurement.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

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- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

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- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Carpet tile.

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

C. Shop Drawings: For carpet tile installation, showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.



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- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Qualification Statements: For Installer.
- D. Sample Warranties: For carpet tile.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For carpet tiles. Include the following:
  - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet Tile: Full-size units equal to 2 percent of amount installed for each type indicated, but no fewer than 10 full-size units.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.7 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended in writing by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

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1.8 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
  2. Failures include, but are not limited to, the following:
    - a. More than 10 percent loss of face fiber, edge raveling, snags, and runs.
    - b. Loss of tuft-bind strength.
    - c. Excess static discharge.
    - d. Delamination.
    - e. Dimensional instability.
  3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE (CPTT 1, 3)

- A. **Manufacturers:** Subject to compliance with requirements, provide WG 200 by Interface Inc., or comparable product by one of the following:
1. Bentley Mills, Inc.
  2. Interface, Inc.
  3. J&J Flooring Group LLC.
  4. Mannington Commercial; a business unit of Mannington Mills, Inc.
  5. Shaw Industries Group, Inc.; Berkshire Hathaway Company.
  6. Tarkett USA.
- B. Color: As selected by Architect from manufacturer's full range.
- C. Pattern: WG 200.
- D. Fiber Content: 100 percent recycled nylon.
- E. Fiber Type: Aquafil nylon.
- F. Pile Characteristic: Tufted texture loop pile.
- G. Density: 8,536 oz./yd<sup>3</sup>.
- H. Pile Thickness: 0.10 inches for finished carpet tile.
- I. Stitches: 9.90 stitches per inch.
- J. Gauge: 1/12 inch.
- K. Primary Backing/Backcoating: Manufacturer's standard composite materials.

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- L. Secondary Backing: GlasBac.
- M. Backing System: GlasBac.
- N. Size: 19.69 by 19.69 inches.
- O. Applied Treatments:
  - 1. Soil-Resistance Treatment: Manufacturer's standard treatment.
  - 2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
    - a. Antimicrobial Activity: Not less than 2 mm halo of inhibition for gram-positive bacteria, not less than 1 mm halo of inhibition for gram-negative bacteria, and no fungal growth, in accordance with AATCC 174.
- P. Sustainable Design Requirements:
  - 1. Sustainable Product Certification: Platinum level certification in accordance with NSF/ANSI 140.
- Q. Performance Characteristics:
  - 1. Texture Appearance Retention Rating (TARR): Severe traffic, 3.5 minimum in accordance with ASTM D7330.
  - 2. Dry Breaking Strength: Not less than 100 lbf in accordance with ASTM D2646.
  - 3. Delamination: Not less than 4 lbf/in. in accordance with ASTM D3936.
  - 4. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
  - 5. Colorfastness to Crocking: Not less than 4, wet and dry, in accordance with AATCC 165.
  - 6. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) in accordance with AATCC 16.3 Option 3.

2.2 CARPET TILE (CPTT 2)

- A. **Manufacturers:** Subject to compliance with requirements, provide WG 100 by Interface Inc., or comparable product by one of the following:
  - 1. Bentley Mills, Inc.
  - 2. J&J Flooring Group LLC.
  - 3. Mannington Commercial; a business unit of Mannington Mills, Inc.
  - 4. Milliken & Company.
  - 5. Shaw Industries Group, Inc.; Berkshire Hathaway Company.
  - 6. Tarkett USA.
- B. Color: As selected by Architect from manufacturer's full range.
- C. Pattern: WG 100.
- D. Fiber Content: 100 percent recycled nylon.

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- E. Fiber Type: Aquafil nylon.
- F. Pile Characteristic: Tufted texture loop pile.
- G. Density: 8,716 oz./yd<sup>3</sup>.
- H. Pile Thickness: 0.10 inches for finished carpet tile.
- I. Stitches: 9.90 stitches per inch.
- J. Gauge: 1/12 inch.
- K. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- L. Secondary Backing: GlasBac.
- M. Backing System: GlasBac.
- N. Size: 19.69 by 19.69 inches.
- O. Applied Treatments:
  - 1. Soil-Resistance Treatment: Manufacturer's standard treatment.
  - 2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
    - a. Antimicrobial Activity: Not less than 2 mm halo of inhibition for gram-positive bacteria, not less than 1 mm halo of inhibition for gram-negative bacteria, and no fungal growth, in accordance with AATCC 174.
- P. Sustainable Design Requirements:
  - 1. Sustainable Product Certification: Platinum level certification in accordance with NSF/ANSI 140.
- Q. Performance Characteristics:
  - 1. Texture Appearance Retention Rating (TARR): Severe traffic, 3.5 minimum in accordance with ASTM D7330.
  - 2. Dry Breaking Strength: Not less than 100 lbf in accordance with ASTM D2646.
  - 3. Delamination: Not less than 4 lbf/in. in accordance with ASTM D3936.
  - 4. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
  - 5. Colorfastness to Crocking: Not less than 4, wet and dry, in accordance with AATCC 165.
  - 6. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) in accordance with AATCC 16.3 Option 3.

2.3 CARPET TILE (CPTT 4)

- A. Manufacturers: Subject to compliance with requirements, provide Urban Retreat 101 by Interface Inc., or comparable product by one of the following:

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1. Bentley Mills, Inc.
  2. J&J Flooring Group LLC.
  3. Mannington Commercial; a business unit of Mannington Mills, Inc.
  4. Mohawk Carpet, LLC; The Mohawk Group.
  5. Shaw Industries Group, Inc.; Berkshire Hathaway Company.
  6. Tarkett USA.
- B. Color: As selected by Architect from manufacturer's full range.
- C. Pattern: Urban Retreat 101.
- D. Fiber Content: 100 percent recycled nylon.
- E. Fiber Type: Aquafil nylon.
- F. Pile Characteristic: Engaged tufted pattern loop pile.
- G. Density: 6,734 oz./yd.
- H. Pile Thickness: 0.14 inches for finished carpet tile.
- I. Stitches: 13.00 stitches per inch.
- J. Gauge: 1/10 inch.
- K. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- L. Secondary Backing: Manufacturer's standard material.
- M. Backing System: GlasBac.
- N. Size: 19.69 by 19.69 inches.
- O. Applied Treatments:
1. Soil-Resistance Treatment: Manufacturer's standard treatment.
  2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
    - a. Antimicrobial Activity: Not less than 2 mm halo of inhibition for gram-positive bacteria, not less than 1 mm halo of inhibition for gram-negative bacteria, and no fungal growth, in accordance with AATCC 174.
- P. Sustainable Design Requirements:
1. Sustainable Product Certification: Platinum level certification in accordance with NSF/ANSI 140.
- Q. Performance Characteristics:
1. Texture Appearance Retention Rating (TARR): Heavy traffic, 3.0 minimum in accordance with ASTM D7330.

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2. Dry Breaking Strength: Not less than 100 lbf in accordance with ASTM D2646.
3. Delamination: Not less than 4 lbf/in. in accordance with ASTM D3936.
4. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
5. Colorfastness to Crocking: Not less than 4, wet and dry, in accordance with AATCC 165.
6. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) in accordance with AATCC 16.3 Option 3.

2.4 CARPET TILE (CPTT 5)

- A. Manufacturers: Subject to compliance with requirements, provide Urban Retreat 103 by Interface Inc., or comparable product by one of the following:
1. Bentley Mills, Inc.
  2. J&J Flooring Group LLC.
  3. Mannington Commercial; a business unit of Mannington Mills, Inc.
  4. Mohawk Carpet, LLC; The Mohawk Group.
  5. Shaw Industries Group, Inc.; Berkshire Hathaway Company.
  6. Tarkett USA.
- B. Color: As selected by Architect from manufacturer's full range.
- C. Pattern: Urban Retreat 103.
- D. Fiber Content: 100 percent recycled nylon.
- E. Fiber Type: Aquafil nylon.
- F. Pile Characteristic: Engaged tufted pattern loop pile.
- G. Density: 7,149 oz./cu. yd.
- H. Pile Thickness: 0.14 inches for finished carpet tile.
- I. Stitches: 7.3 stitches per inch.
- J. Gauge: 1/10 inch.
- K. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- L. Secondary Backing: Manufacturer's standard material.
- M. Backing System: GlasBac.
- N. Size: 19.69 by 19.69 inches.
- O. Applied Treatments:
1. Soil-Resistance Treatment: Manufacturer's standard treatment.
  2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

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- a. Antimicrobial Activity: Not less than 2 mm halo of inhibition for gram-positive bacteria, not less than 1 mm halo of inhibition for gram-negative bacteria, and no fungal growth, in accordance with AATCC 174.

P. Sustainable Design Requirements:

1. Sustainable Product Certification: Platinum level certification in accordance with NSF/ANSI 140.

Q. Performance Characteristics:

1. Texture Appearance Retention Rating (TARR): Moderate traffic, 2.5 minimum in accordance with ASTM D7330.
2. Dry Breaking Strength: Not less than 100 lbf in accordance with ASTM D2646.
3. Delamination: Not less than 4 lbf/in. in accordance with ASTM D3936.
4. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
5. Colorfastness to Crocking: Not less than 4, wet and dry, in accordance with AATCC 165.
6. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) in accordance with AATCC 16.3 Option 3.

2.5 CARPET TILE (CPTT 6)

- A. Manufacturers: Subject to compliance with requirements, provide B602 Net Effect by Interface Inc., or comparable product by one of the following:

1. Bentley Mills, Inc.
2. J&J Flooring Group LLC.
3. Mannington Commercial; a business unit of Mannington Mills, Inc.
4. Mohawk Carpet, LLC; The Mohawk Group.
5. Shaw Industries Group, Inc.; Berkshire Hathaway Company.
6. Tarkett USA.

- B. Color: As selected by Architect from manufacturer's full range.

- C. Pattern: B602 Net Effect.

- D. Fiber Content: 100 percent recycled nylon.

- E. Fiber Type: Aquafil nylon.

- F. Pile Characteristic: Engaged tufted pattern loop pile.

- G. Density: 6,039 oz./cu. yd.

- H. Pile Thickness: 0.15 inches for finished carpet tile.

- I. Stitches: 7.00 stitches per inch.

- J. Gauge: 1/10 inch.

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- K. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- L. Secondary Backing: Manufacturer's standard material.
- M. Backing System: GlasBac.
- N. Size: 19.69 by 19.69 inches.
- O. Applied Treatments:
  - 1. Soil-Resistance Treatment: Manufacturer's standard treatment.
  - 2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
    - a. Antimicrobial Activity: Not less than 2 mm halo of inhibition for gram-positive bacteria, not less than 1 mm halo of inhibition for gram-negative bacteria, and no fungal growth, in accordance with AATCC 174.
- P. Sustainable Design Requirements:
  - 1. Sustainable Product Certification: Platinum level certification in accordance with NSF/ANSI 140.
- Q. Performance Characteristics:
  - 1. Texture Appearance Retention Rating (TARR): Moderate traffic, 2.5 minimum in accordance with ASTM D7330.
  - 2. Dry Breaking Strength: Not less than 100 lbf in accordance with ASTM D2646.
  - 3. Delamination: Not less than 4 lbf/in. in accordance with ASTM D3936.
  - 4. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
  - 5. Colorfastness to Crocking: Not less than 4, wet and dry, in accordance with AATCC 165.
  - 6. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) in accordance with AATCC 16.3 Option 3.

2.6 CARPET TILE (CPTT 7)

- A. Manufacturers: Subject to compliance with requirements, provide Bridge Creek by Interface Inc., or comparable product by one of the following:
  - 1. Bentley Mills, Inc.
  - 2. J&J Flooring Group LLC.
  - 3. Mannington Commercial; a business unit of Mannington Mills, Inc.
  - 4. Mohawk Carpet, LLC; The Mohawk Group.
  - 5. Shaw Industries Group, Inc.; Berkshire Hathaway Company.
  - 6. Tarkett USA.
- B. Color: As selected by Architect from manufacturer's full range.
- C. Pattern: Bridge Creek.



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- D. Fiber Content: 100 percent recycled nylon.
- E. Fiber Type: Aquafil nylon.
- F. Pile Characteristic: Engaged tufted pattern loop pile.
- G. Density: 8,914 oz./cu yd.
- H. Pile Thickness: 0.10 inches for finished carpet tile.
- I. Stitches: 10.00 stitches per inch.
- J. Gauge: 1/10 inch.
- K. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- L. Secondary Backing: Manufacturer's standard material.
- M. Backing System: GlasBac.
- N. Size: 19.69 by 19.69 inches.
- O. Applied Treatments:
  - 1. Soil-Resistance Treatment: Manufacturer's standard treatment.
  - 2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
    - a. Antimicrobial Activity: Not less than 2 mm halo of inhibition for gram-positive bacteria, not less than 1 mm halo of inhibition for gram-negative bacteria, and no fungal growth, in accordance with AATCC 174.
- P. Sustainable Design Requirements:
  - 1. Sustainable Product Certification: Platinum level certification in accordance with NSF/ANSI 140.
- Q. Performance Characteristics:
  - 1. Texture Appearance Retention Rating (TARR): Severe traffic, 3.5 minimum in accordance with ASTM D7330.
  - 2. Dry Breaking Strength: Not less than 100 lbf in accordance with ASTM D2646.
  - 3. Delamination: Not less than 4 lbf/in. in accordance with ASTM D3936.
  - 4. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
  - 5. Colorfastness to Crocking: Not less than 4, wet and dry, in accordance with AATCC 165.
  - 6. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) in accordance with AATCC 16.3 Option 3.

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2.7 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended in writing by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive types to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and that are recommended in writing by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 95 percent relative humidity level measurement.
    - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, in accordance with manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

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- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns indicated on Drawings.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended in writing by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
  - 1. Remove excess adhesive and other surface blemishes using cleaner recommended in writing by carpet tile manufacturer.
  - 2. Remove yarns that protrude from carpet tile surface.
  - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 13.7.
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

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SECTION 098433 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
  - 1. Sound-absorbing wall panels.
- B. Related Requirements:
  - 1. Section 098436 “Sound Absorbing Ceiling Units” for acoustical ceiling panels.

1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Sustainable Design Submittals:
  - 1. Product Data: For recycled content, indicating percentage of post-consumer and pre-consumer recycled content and cost.
  - 2. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
  - 3. Chain-of-Custody Qualification Data: For manufacturer and vendor.
  - 4. Product Data: For adhesives, indicating VOC content.
  - 5. Laboratory Test Reports: For wall materials, indicating compliance with the VOC emissions evaluation.
- C. Product Data: For each type of product.
- D. Shop Drawings: For unit assembly and installation.

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1. Include plans, elevations, sections, and mounting devices and details.
2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
3. Include details at cutouts and penetrations for other work.
4. Include direction of fabric weave and pattern matching.

E. Samples for Verification: For the following products:

1. Fabric: Full-width by approximately 36-inch-long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Electrical outlets, switches, and thermostats.
  2. Items penetrating or covered by units including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Alarms.
    - e. Sprinklers.
    - f. Access panels.
  3. Show operation of hinged and sliding components covered by or adjacent to units.
- C. Product Certificates: For each type of unit.
- D. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.

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1. Build mockup of typical wall area of 48 inches wide by full panel height for each panel type.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to the following:
    - a. Acoustical performance.
    - b. Fabric sagging, distorting, or releasing from panel edge.
    - c. Warping of core.
  2. Warranty Period: Two years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Verify wall materials comply with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.3 SOUND-ABSORBING WALL UNITS

- A. Sound-Absorbing Wall Panel (AWP-1): Manufacturer's standard panel construction consisting of facing material.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Conwed Wall Panel / Paint / IR, or comparable product by one of the following:
    - a. Armstrong Ceiling & Wall Solutions.
    - b. Armstrong World Industries, Inc.
    - c. Decoustics; CertainTeed Architectural Products; a Saint Gobain company.
    - d. Sound Concepts.
  2. Panel Shape: Flat.
  3. Mounting: Back mounted with manufacturer's standard metal clips or bar hangers.
  4. Core: Dimensionally stable rigid fiberglass.
  5. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
  6. Corner Detail in Elevation: Square with continuous edge profile indicated.
  7. Reveals between Panels: As indicated on Drawings.
  8. Facing Material: Painted.

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9. Acoustical Performance: Sound absorption NRC of not less than 0.90 according to ASTM C423 for Type A mounting according to ASTM E795.
10. Nominal Overall Panel Thickness: 1.125 inches.
11. Panel Width: As indicated on Drawings.
12. Panel Height: As indicated on Drawings.

B. Sound Absorbing Wall Panels (AWP-2):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Conwed Wall Panel / Fabric / A, or comparable product by one of the following:
  - a. Armstrong Ceiling & Wall Solutions.
  - b. Armstrong World Industries, Inc.
  - c. Decoustics; CertainTeed Architectural Products; a Saint Gobain company.
  - d. Sound Concepts.
2. Panel Shape: Flat.
3. Mounting: Back mounted with manufacturer's standard metal clips or bar hangers secured to substrate.
4. Core: Dimensionally stable rigid fiberglass.
  - a. Core-Face Layer: Manufacturer's standard.
5. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
6. Edge Profile: Square.
7. Corner Detail: Square with continuous edge profile indicated.
8. Facing Material: Painted.
9. Acoustical Performance: Sound absorption NRC 0.80 in accordance with ASTM C423 for Type A mounting in accordance with ASTM E795.
10. Nominal Thickness: 1 inch.
11. Panel Width: As indicated on Drawings.
12. Panel Height: As indicated on Drawings.

C. Sound Absorbing Wall Panels (AWP-3):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Takeform Oomph Shapes, or comparable product by one of the following:
  - a. Armstrong World Industries, Inc.
  - b. Decoustics; CertainTeed Architectural Products; a Saint Gobain company.
  - c. Xorel Artform.
2. Panel Shape: SH-11 Marquise.
3. Mounting: Adhered to substrate per manufacturer's written instructions.
4. Core: Solution-dyed 60 percent recycled fibrous polyester.
  - a. Core-Face Layer: Manufacturer's standard.
5. Edge Construction: Manufacturer's standard with no frame.
6. Edge Profile: Chamfered (beveled).
7. Acoustical Performance: Sound absorption NRC 0.45 in accordance with ASTM C423 for Type A mounting in accordance with ASTM E795.



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8. Nominal Thickness: 0.5 inch.
9. Panel Width: As indicated on Drawings.
10. Panel Height: As indicated on Drawings.
11. Warranty: Five years.

2.4 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Edge Hardening: For felt cores, chemically harden core edges and areas of core where mounting devices are attached.
- C. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.
- D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
  1. Thickness.
  2. Edge straightness.
  3. Overall length and width.
  4. Squareness from corner to corner.
  5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches, noncumulative.

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- B. Variation of Joint Width: Not more than 1/16-inch variation from hairline in 48 inches, noncumulative.

3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

SECTION 098436 - SOUND-ABSORBING CEILING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
  - 1. Sound-absorbing ceiling panels.
- B. Related Requirements:
  - 1. Section 098433 “Sound Absorbing Wall Units” for acoustical wall panels.

1.2 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include panel edge, core material, and mounting indicated.
- C. Sustainable Design Submittals:
  - 1. Environmental Product Declaration (EPD): For each product.
  - 2. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
  - 3. Laboratory Test Reports: For ceiling products, indicating compliance with requirements for low-emitting materials.
- D. Shop Drawings: For unit assembly and installation.
  - 1. Include reflected ceiling plans, elevations, sections, and mounting devices and details.
  - 2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge profile and core materials.

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- E. Samples for Initial Selection: For each type of fabric facing.
- F. Samples for Verification: For the following products:
  - 1. Panel Edge: 12-inch-long Sample(s) showing each edge profile, corner, and finish.
  - 2. Core Material: 12-inch-square Sample at corner.
  - 3. Mounting Devices: Full-size Samples.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Electrical outlets.
  - 2. Suspended ceiling components above ceiling units.
  - 3. Structural members to which suspension devices will be attached.
  - 4. Items penetrating or covered by units including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Alarms.
    - e. Sprinklers.
    - f. Access panels.
  - 5. Show operation of hinged and sliding components covered by or adjacent to units.
- C. Product Certificates: For each type of unit.
- D. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain-removal instructions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

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1. Mounting Devices: Full-size units equal to 10 devices.

1.8 QUALITY ASSURANCE

- A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
  1. Build mockup of typical ceiling area of two adjacent panels.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature of 60 to 85 deg F and humidity conditions are not more than 70 percent relative humidity prior to start of installation.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.

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1. Failures include, but are not limited to, the following:
  - a. Acoustical performance.
  - b. Fabric sagging, distorting, or releasing from panel edge.
  - c. Warping of core.
2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain ceiling units specified in this Section from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Ceiling products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

2.3 SOUND-ABSORBING CEILING UNITS (ACT-2A, B)

- A. Sound-Absorbing Ceiling Panel : Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Conwed Cloud/Paint/A, or comparable product by one of the following:
    - a. Armstrong Ceiling & Wall Solutions
    - b. Armstrong World Industries, Inc
    - c. Certainteed.
    - d. Decoustics; CertainTeed Architectural Products; a Saint Gobain company

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2. Panel Shape: Flat.
3. Mounting: Back mounted with manufacturer's standard acoustical anchors, secured to substrate.
4. Core: Dimensionally stable rigid fiberglass.
5. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
6. Edge Profile: Square.
7. Corner Detail in Elevation: Square with continuous edge profile indicated.
8. Facing Material: Painted.
9. Acoustical Performance: Sound absorption NRC not less than 0.95 according to ASTM C423 for E400 mounting according to ASTM E795.
10. Nominal Overall Panel Thickness: 1-1/2 inches.
11. Panel Sizes:
  - a. ACT-2A: 36 inches wide by 72 inches long.
  - b. ACT-2B: 36 inches wide by 96 inches long.

## 2.4 MATERIALS

### A. Sustainable Design Requirements:

1. Composite Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
2. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 30 percent.

### B. Core Materials: Manufacturer's standard.

1. Glass-Fiber Board: ASTM C612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft., unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

### C. Facing Material: Painted, soft texture finish.

### D. Mounting Devices: Concealed on back or top edge of unit, recommended by manufacturer to support weight of unit.

## 2.5 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Measure each area and establish layout of panels sizes indicated on Drawings within a given area.
- C. Edge Hardening: For glass-fiber board cores, chemically harden core edges and areas of core where mounting devices are attached.

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1. Square Corners: Painted resin-hardened edge.
- D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
1. Thickness.
  2. Edge straightness.
  3. Overall length and width.
  4. Squareness from corner to corner.
  5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.3 INSTALLATION TOLERANCES

- A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch in 48 inches, noncumulative.
- B. Variation from Level or Slope: Plus or minus 1/16 inch.

3.4 CLEANING

- A. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.
- B. Touch-up, repair or replace damaged units until satisfactory results are obtained.

END OF SECTION



## SECTION 099123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Concrete.
  - 2. Steel and iron.
  - 3. Galvanized metal.
  - 4. Aluminum (not anodized or otherwise coated).
  - 5. Gypsum board.
  - 6. Wood.
- B. Related Requirements:
  - 1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
  - 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
  - 3. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
  - 4. Section 055119 "Metal Grating Stairs" for shop priming metal grating stairs.
  - 5. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
  - 6. Section 099600 "High-Performance Coatings" for tile-like coatings.

#### 1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

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- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.
- D. Sustainable Design Submittals:
  - 1. Product Data: For paints and coatings, indicating VOC content.
  - 2. Environmental Product Declaration (EPD): For each product.
  - 3. Health Product Declaration (HPD): For each product.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 1 gal. of each material and color applied.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. California Paints.
3. Conco Paints.
4. Coronado Paint; Benjamin Moore Company.
5. Diamond Vogel Paints.
6. Dulux (formerly ICI Paints); a brand of AkzoNobel.
7. Dunn-Edwards Corporation.
8. Duron, Inc.
9. Frazee Paint; Comex Group.
10. Glidden Professional.
11. HEMPEL A/S.
12. Kelly-Moore Paint Company Inc.
13. Kwal Paint; Comex Group.
14. M.A.B. Paints.
15. McCormick Paints.
16. Parker Paint; Comex Group.
17. PPG Paints.
18. Pratt & Lambert.
19. Rodda Paint Co.
20. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
21. Sherwin-Williams Company (The).
22. United Gilsonite Laboratories.
23. Valspar Corporation - Architectural (Pro).
24. Vista Paint Corporation.
25. Zinsser; Rust-Oleum Corporation.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Low-Emitting Materials: For field applications that are inside the weatherproofing system, verify 90 percent of paints and coatings comply with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

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- D. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
  2. Masonry (Clay and CMUs): 12 percent.
  3. Gypsum Board: 12 percent.
  4. Wood: 15 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

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- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

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1. Paint the following work where exposed in occupied spaces:
  - a. Equipment, including panelboards.
  - b. Uninsulated metal piping.
  - c. Uninsulated plastic piping.
  - d. Pipe hangers and supports.
  - e. Metal conduit.
  - f. Plastic conduit.
  - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
  - h. Other items as directed by Architect.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
  1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
  2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
  3. Allow empty paint cans to dry before disposal.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
  1. High-Performance Architectural Latex System MPI INT 3.1C:
    - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
    - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
    - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.
- B. Concrete Substrates, Traffic Surfaces:
  1. Water-based concrete floor sealer system MPI INT 3.2G.

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- a. First coat: Sealer, water based, for concrete floors matching topcoat.
- b. Topcoat: Sealer, water-based, for concrete floors MPI #99.

C. Steel Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 5.1S:

- a. Prime Coat: Primer, rust inhibitive, water based MPI #107.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

D. Galvanized-Metal Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 5.3N:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

E. Aluminum (not Anodized or Otherwise Coated) Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 5.4G:

- a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

F. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:

- a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

2. High-Performance Architectural Latex System: MPI INT 3.1C.

- a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
- b. Intermediate Coat: Latex, interior, high-performance architectural, matching topcoat.
- c. Topcoat: Latex, interior, high-performance architectural,(MPI Gloss Level G3).

G. Wood Substrates: Wood trim.

1. Institutional Low-Odor/VOC Latex System MPI INT 6.3V:

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- a. Prime Coat: Primer, latex for interior wood, MPI #39.
- b. Intermediate Coat: Latex, interior, institutional low-odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low-odor/VOC, semi-gloss (MPI gloss Level 5), MPI #147.

END OF SECTION



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SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood stains.
2. Transparent finishes.

B. Related Requirements:

1. Section 064023 "Interior Architectural Woodwork" for shop-finished running trim.
2. Section 099123 "Interior Painting" for stains and transparent finishes on concrete floors.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. For each type of product.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

C. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.

1. Size: 8 inches square or 8 inches long.
2. Label each coat of each Sample.
3. Label each Sample for location and application area.

D. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

E. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Health Product Declaration: For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

1.3 MOCKUPS

A. Apply mockups of each finish system indicated and each color selected to demonstrate aesthetic effects and to set quality standards for materials and execution.

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1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
  - a. Vertical and Horizontal Surfaces: Provide samples of at least 10 sq. ft.
  - b. Other Items: Architect will designate items or areas required.
2. Final approval of stain color selections will be based on mockups.
  - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures of less than 5 deg F above the dew point, or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Behr Paint Company (Behr Process LLC).
  2. Benjamin Moore & Co.
  3. Coronado Paint; Benjamin Moore & Co.
  4. Diamond Vogel Paint Company.
  5. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).
  6. Hempel (USA), Inc.
  7. Lenmar Lacquers; Benjamin Moore & Co.
  8. PPG Paints; PPG Industries, Inc.
  9. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
  10. Rodda Paint Co.
  11. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.

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12. [Sherwin-Williams Company \(The\).](#)
13. [United Gilsonite Laboratories \(UGL\).](#)
14. [Vista Paint Corporation.](#)

2.2 SOURCE LIMITATIONS

- A. Source Limitations: Obtain each coating product from single source from single manufacturer.

2.3 MATERIALS, GENERAL

- A. Material Compatibility:
  1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- B. **VOC Content:** For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
  1. Primers, Sealers, and Undercoaters: 100 g/L.
  2. Clear Wood Finishes, Varnishes: 275 g/L.
  3. Clear Wood Finishes, Lacquers: 275 g/L.
  4. Shellacs, Clear: 730 g/L.
  5. Stains: 100 g/L.
- C. Low-Emitting Materials: For field applications that are inside the weatherproofing system, verify 90 percent of paints and coatings comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Stain Colors: As selected by Architect from manufacturer's full range.

2.4 WOOD STAINS

- A. Stain, Interior, Semitransparent, for Interior Wood: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new interior wood surfaces that are to be finished with a clear varnish.
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. PPG Paints; PPG Industries, Inc.
    - b. [Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.](#)
    - c. [Rust-Oleum Corporation; a subsidiary of RPM International, Inc.](#)
    - d. [Sherwin-Williams Company \(The\).](#)

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2.5 TRANSPARENT FINISHES

- A. Varnish, Interior, Water Based, Clear, Satin: Water-based clear satin coating for interior wood trim, frames, doors, paneling and cabinetry.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Benjamin Moore & Co.
    - b. Lenmar Lacquers; Benjamin Moore & Co.
    - c. PPG Paints; PPG Industries, Inc.
    - d. Sherwin-Williams Company (The).
  - 2. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.
- B. Varnish, Interior, Water Based, Clear, Semigloss: Water-based clear semigloss coating for interior wood trim, frames, doors, paneling and cabinetry.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Benjamin Moore & Co.
    - b. Lenmar Lacquers; Benjamin Moore & Co.
    - c. PPG Paints; PPG Industries, Inc.
    - d. Sherwin-Williams Company (The).
  - 2. Gloss Level: Manufacturer's standard semigloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Interior Wood Substrates: 13 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
  - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

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3.2 PREPARATION

- A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
  - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
  - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
  - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
- C. Interior Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces exposed to view and dust off.
  - 3. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry. (Do not fill holes in wood to match CLT.)

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for finish and substrate indicated.
  - 2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
  - 3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

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- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

### 3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Wood Substrates, Glue-Laminated Construction:

- 1. Polyurethane Varnish over Stain System:

- a. Stain Coat: Stain, semitransparent, for interior wood.
    - b. First Intermediate Coat: Polyurethane varnish matching topcoat.
    - c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
    - d. Topcoat: Varnish, interior, polyurethane, oil modified satin.

- B. Wood Substrates, Wood Trim, and Wood Board Paneling:

- 1. Water-Based Varnish over Stain System:

- a. Stain Coat: Stain, semitransparent, for interior wood.
    - b. First Intermediate Coat: Water-based varnish matching topcoat.
    - c. Second Intermediate Coat: Water-based varnish matching topcoat.
    - d. Topcoat: Varnish, water based, clear, satin.

- C. Wood Substrates, Wood Paneling:

- 1. Water-Based Varnish over Stain System:

- a. Stain Coat: Stain, semitransparent, for interior wood.
    - b. First Intermediate Coat: Water-based varnish matching topcoat.
    - c. Second Intermediate Coat: Water-based varnish matching topcoat.
    - d. Topcoat: Varnish, water based, clear, satin.

END OF SECTION

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SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass markerboards.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. Glass markerboards.

C. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
2. Include electrical characteristics for motorized units.

D. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Include sections of typical trim members.

E. Product Schedule: For visual display units.

1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Qualification Data: For Installer.

C. Product Test Reports: For each visual display unit.

D. Sample Warranties: For manufacturer's special warranties.

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1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

- A. Warranty for Glass Markerboards: Manufacturer agrees to repair or replace boards that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.



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2.2 GLASS MARKERBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide "Claridge" Glass Whiteboard or comparable product by one of the following:
  - 1. Clarus Glassboards, LLC.
  - 2. Egan Visual.
  - 3. ghent; a GMi Company.
- B. Glass Markerboards: Fabricated of 6-mm tempered low-iron glass with steel backing for use with magnets.
  - 1. Edge Treatment: Smooth polished edge with eased corners.
  - 2. Surface: Matte.
  - 3. Color: To be selected from manufacturer's standard colors.
- C. Mounting:
  - 1. Round, stainless steel standoffs, holding glass approximately 1 inch from wall surface; mounted through holes in markerboard.
- D. Marker Tray: Aluminum, attached with magnet.
- E. Size: 48 by 48 inches.

2.3 MATERIALS

- A. Clear Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.
- B. Extruded Aluminum: ASTM B221 (ASTM B221M), Alloy 6063.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies:
  - 1. Attach stand-offs to wall surfaces and to visual display board assemblies. Secure tops and bottoms of boards to walls.
- C. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Cover and protect visual display units after installation and cleaning.

END OF SECTION

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SECTION 101416 - PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal plaques.

B. Related Requirements:

1. Section 101423 "Panel Signage" and Section 101423.16 "Room-Identification Panel Signage" for plaques or signs similar to metal plaques, with or without frames, except that they are made of materials other than solid metal.

1.2 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Shop Drawings: For plaques.
1. Include fabrication and installation details and attachments to other work.
  2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  3. Show message list, typestyles, graphic elements, and layout for each plaque at least half size.
- D. Samples for Verification: For each type of plaque showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated.
- E. Product Schedule: For plaques. Use same designations indicated on Drawings or specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Sample Warranty: For special warranty.

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1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For plaques to include in maintenance manuals.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
  - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.2 METAL PLAQUES

- A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.R.K. Ramos.
    - b. ACE Sign Systems, Inc.
    - c. Erie Landmark Company; a division of Paul W. Zimmerman Foundaries, Inc.
    - d. Gemini Signage; Gemini, Inc.
    - e. Matthews International Corporation; Bronze Division.
    - f. Metallic Arts.
    - g. Signs & Decal Corp.
    - h. Southwell Company (The).
  - 2. Plaque Material: Cast aluminum, brass, or bronze.
  - 3. Plaque Thickness: 0.25 inch.
  - 4. Finishes:

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- a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
5. Background Texture: As selected by Architect from manufacturer's full range.
6. Integrally Cast Border Style: As indicated on Drawings.
7. Applied Frame Material, Style, and Finish: As indicated on Drawings.
8. Mounting: As indicated on Drawings.
9. Text and Typeface: Accessible raised characters and Braille; typeface as selected by Architect from manufacturer's full range.

## 2.3 MATERIALS

- A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by plaque manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Brass Castings: ASTM B584, alloy recommended by manufacturer and finisher for finish indicated.
- D. Bronze Castings: ASTM B584, alloy recommended by manufacturer and finisher for finish indicated.

## 2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:
  1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. For exterior exposure, furnish nonferrous-metal devices unless otherwise indicated.
  3. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
    - b. Fastener Heads: For nonstructural connections, use flathead screws and bolts with tamper-resistant slots unless otherwise indicated.
  4. Plaque Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.
    - b. Through Fasteners: Exposed metal fasteners matching plaque finish, with type of head indicated, installed in predrilled holes.
- B. Adhesive: As recommended by plaque manufacturer.

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2.5 FABRICATION

- A. General: Provide manufacturer's standard plaques according to requirements indicated.
  - 1. Preassemble plaques in the shop to greatest extent possible. Disassemble plaques only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
  - 6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Surface-Engraved Graphics: Machine-engrave characters and other graphic devices into indicated plaque surface to produce precisely formed copy, incised to uniform depth.
  - 1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
- C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF METAL PLAQUES

- A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
  - 2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
  - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
  - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
  - 2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.
  - 3. Brackets: Remove loose debris from substrate surface and install bracket supports in position, so that plaque is correctly located and aligned.
  - 4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of plaque and of suitable quantity to support weight of plaque after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as plaque is applied and to prevent visibility of cured adhesive at plaque edges. Place plaque in position, and push to engage adhesive. Temporarily support plaque in position until adhesive fully sets.

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3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as plaques are installed.
- C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION



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SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimensional characters.
  - a. Cast dimensional characters.

1.2 COORDINATION

- A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
1. **Product Data:** For adhesives, indicating VOC content.
  2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- D. Shop Drawings: For signs.
1. Include fabrication and installation details and attachments to other work.
  2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  3. Show message list, typestyles, graphic elements, and layout for each sign.
- E. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
1. Include representative Samples of available typestyles and graphic symbols.
- F. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

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1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For signs to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Separation or delamination of sheet materials and components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DIMENSIONAL CHARACTERS

- A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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- a. [A.R.K. Ramos.](#)
  - b. [ACE Sign Systems, Inc.](#)
  - c. [ASI Sign Systems, Inc.](#)
  - d. [Cosco.](#)
  - e. [Gemini Signage; Gemini, Inc.](#)
  - f. [Matthews International Corporation; Bronze Division.](#)
  - g. [Metal Arts.](#)
  - h. [Metallic Arts.](#)
  - i. [Southwell Company \(The\).](#)
2. Character Material: Cast aluminum.
  3. Character Height: As indicated on Drawings.
  4. Thickness: As indicated on Drawings.
  5. Finishes:
    - a. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
  6. Mounting: Concealed studs.
  7. Typeface: To be selected.

## 2.2 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

## 2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. For exterior exposure, furnish stainless steel devices unless otherwise indicated.
  3. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
- B. Adhesive: As recommended by sign manufacturer.
  1. [Verify adhesives have a VOC](#) content of [70] g/L or less.
  2. [Verify adhesive complies with the](#) testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of

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Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
  - 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
  - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

## 2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
- B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  - 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
  - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Wood Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE AND DIRECTORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.
- B. Related Requirements:
  - 1. Section 101419 “Dimensional Letter Signage” for dimensional letters.
  - 2. Section 101423 “Panel Signage” for graphic panels.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Shop Drawings: For room-identification signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

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1. Room-Identification Signs: Full-size Sample.
2. Full-size Samples, if approved, will be returned to Contractor for use in Project.

- E. Signage Schedule: For room-identification signs. Use same designations indicated on Drawings or specified for verification of text.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For Installer and manufacturer.
- C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For signs to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Variable Component Materials: 12 replaceable text inserts of each type.
  2. Tools: One set of specialty tools for assembling signs and replacing variable sign components.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer. Obtain signs from one source and a single manufacturer.

1.10 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

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1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
    - c. Separation or delamination of sheet materials and components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" the ABA standards of the Federal agency having jurisdiction.
- B. It shall be the responsibility of the successful bidder to meet any and all local, state, and federal code requirements in fabricating and installing signs.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Vivid Signage by Takeform Architectural Graphics, or comparable product by one of the following:
    - a. APCO Graphics, Inc.
    - b. ASE, Inc.
    - c. ASI Sign Systems, Inc.
    - d. Best Sign Systems, Inc.
    - e. Clarke Systems.
    - f. Diskey Architectural Signage Inc.
    - g. Inpro Corporation.
    - h. Poblocki Sign Company, LLC.
    - i. Vomar Products, Inc.
  - 2. Laminated-Sheet Sign: Face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
- B. Materials:



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1. Signage shall be capable of accepting direct prints including colors, patterns, graphic images and photography. Prints shall be second surface to protect from scratches, fading or other damage.
2. Signage shall be fabricated of acrylic, .375" thick, comprised of two layers. Edges shall be smooth without chips, burrs, sharp edges or marks. The direct print shall be second surface to prevent scratching, fading or other damage.
3. Acrylic shall be non-glare optically clear with a P99 finish assuring no loss of clarity or composition of the print.
4. Tactile lettering shall be precision machined, raised 1/32", matte PETG and subsurface colored for scratch resistance.
5. The signage shall utilize an acrylic sphere for Grade II Braille inserted directly into a scratch resistant, acrylic face. Braille dots are to be pressure fit in high tolerance drilled holes. Braille dots shall be half hemispherical domed and protruding a minimum 0.025".
6. The signage shall utilize a pressure activated adhesive. The adhesive shall be nonhazardous and shall allow for flexing and deflection of the adhered components due to changes in temperature and humidity without bond failure.
7. Signage shall have an acrylic shim plate. The shim shall lift the sign off the wall to facilitate cleaning and painting without sign removal.
8. All signs shall be provided with appropriate mounting hardware. All hardware shall have a polished anodized finish, architectural in appearance and suitable for the mounting surface.
9. For signs installed on glass, a blank backer is required to be placed on the opposite side of the glass to cover tape and adhesive. The backer shall match the sign in size and shape.

C. Colors, Patterns, Imagery, and Artwork:

1. All images shall have a minimum resolution of 300 dpi.
2. Face and background colors shall be per the drawings.
3. Standard tactile colors shall match manufacturer's ADA standard color selection. Font and font colors shall be per the drawings.

D. Printed Inserts:

1. The signage shall be capable of accepting paper inserts to allow changing and updating as required. Insert components shall have a 0.040" thickness non-glare acrylic window and shall be flush to sign face for a smooth, seamless appearance.
2. The signage contractor shall provide and install all signage inserts.
3. Manufacturer shall provide a template containing layout, font, color, artwork and trim lines to allow Owner to produce inserts on laser or ink jet printer. The template shall be in an Acrobat or Word format (.pdf).

E. Quantities:

1. Code and Facility Signage:
  - a. Sign Type A Exit
  - b. Sign Type B Small Room ID
  - c. Sign Type C Room ID Changeable Insert
  - d. Sign Type D Medium Room ID

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e.	Sign Type E	Stairs
f.	Sign Type F,G	Restroom
g.	Sign Type H	Elevator
h.	Sign Type J	Elevator Level Signs
i.	Sign Type K	Interior Stairwell
j.	Sign Type L	Directory
k.	Sign Type M	Evacuation Map Sign
l.	Sign Type N	Maximum Occupancy Sign
m.	Sign Type P	Dimensional Letters

## 2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.
- C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

## 2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  - 1. Use concealed fasteners and anchors unless indicated to be exposed.
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
    - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045-inch-thick, with adhesive on both sides.

## 2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

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2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts (see para 2.2 D3).

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of

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suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

2. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

### 3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

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SECTION 102219 - DEMOUNTABLE PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Site-assembled demountable partitions.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 RELATED SECTIONS

- A. Section 087100 "Door Hardware" for door hardware.

1.4 REFERENCES

- A. ASTM A 276 - Standard Specification for Stainless Steel Bars and Shapes.
- B. ASTM B 221-06 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- C. ASTM C 1048-04 - Standard Specification for Heat-Treated Uncoated Glass.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data:
1. Site-assembled demountable partitions.
  - 2.
- C. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
  2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- D. Shop Drawings: For demountable partitions.

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1. Include plans, elevations, sections, and attachment details at floors, columns, permanent partitions, and ceilings; and method of erection and disassembly.
  2. Include diagrams for power-, signal-, and control-wiring raceways; and details of access to raceways.
  3. Include type and thickness of glass, hardware, and accessories.
- E. Samples for Initial Selection: For each type of exposed finish.
1. Include Samples of hardware and accessories involving color or finish selection.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from the installers of the items involved:
1. Suspended-ceiling components and dimensioned ceiling-grid layout.
  2. Locations of fixed door and window mullions.
  3. Overhead bracing, seismic restraints, and related structural members.
  4. Ductwork above ceiling.
- C. Qualification Data: For Installer.
- D. Product Certificates: For each type of demountable partition.
- E. Product Test Reports: For each type of demountable-partition assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.7 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For demountable partitions to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- C. Manufacturer Qualifications: Glass partition manufacturer to have minimum five years documented experience in the fabrication of glass partitions of the type required for this project and be capable of providing field service representation during installation.

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- D. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer with a minimum 2 years documented experience in work of this section.
- E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups for demountable partitions including accessories.
    - a. Size: 8'-0" inches by full height.
    - b. Each type of exposed construction.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from damage and exposure to moisture.

1.10 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.11 FIELD CONDITIONS

- A. Finished Spaces: Do not deliver or install demountable partitions until finishes in spaces to receive them are complete, including suspended ceilings, floors, carpeting, and painting.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.12 COORDINATION

- A. Coordinate Work with other operations and installation of adjacent surfaces to avoid damage to installed materials.
- B. Coordinate work with adjacent floor, wall, and ceiling construction to accommodate frame anchorage, track, and concealed hardware.

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- C. Coordinate work with concrete floors and floor finishes for adequate tolerances and clearances between panels and floor finish.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Structural Performance: Provide demountable partitions capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Load-Bearing Capacity: Not less than 300 lb concentrated proof load when tested according to BIFMA X 5.6.
  - 2. Transverse-Load Capacity: Lateral deflection of not more than 1/120 of the overall span when tested under a uniformly distributed load of 5 lb/sq. ft. according to ASTM E72.
- C. Acoustical Performance: Where acoustical rating is indicated, provide demountable-partition assembly tested by a qualified testing agency for sound transmission loss performance according to ASTM E90, calculated according to ASTM E413, and rated for not less than the STC value indicated.
- D. Regulatory Requirements: Provide tempered safety glass for locations subject to human impact as required by the applicable Building Code.

### 2.2 SITE-ASSEMBLED DEMOUNTABLE PARTITIONS

- A. Site-Assembled Demountable Partitions: Site-assembled, demountable-partition assembly and components that are the standard products of manufacturer.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide “Hush Series Wall System” by MetroWall, or comparable by one of the following products:
    - a. Avanti Systems USA.
    - b. DIRT Environmental Solutions.
    - c. Dormakaba USA, Inc.
    - d. Steelcase Inc.
- B. Acoustical Rating: STC 35.
- C. Sliding Doors:
  - 1. HUSH Series frameless surface mounted, sliding glass doors with tempered glass of minimum thickness matching glass partitions
  - 2. Hardware: Frameless surface mounted hardware:



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- a. Sliding Door Devices (2 per door): Concealed, top hung, 4-roller, clamp-on “silent-glide” carrier assembly (rated for 220 lb door)
- b. Integral aluminum roller track
- c. Hydraulic “soft-close” mechanisms for both open & close positions
- d. Solid aluminum stop blocks with neoprene cushion stops
- e. Tubular Pull: Stainless steel or matte black, lengths and diameter vary
- f. 1/2” Clear Tempered Glass panel, 38 1/2” W x custom height, prep for handle

D. Hinged Doors:

1. Frameless glass hinged doors (prep for hinges & latchset):
  - a. Hardware:
    - 1) Hinges: Stainless Steel offset butt hinge for glass doors.
    - 2) Latchset: Type to be selected from manufacturer's full range.
    - 3) Stop: Floor mounted Stainless with neoprene ring bumper.
2. Frameless glass pivot doors:
  - a. Hardware:
    - 1) Top & Bottom Patch Fittings.
    - 2) Concealed Overhead Closer with adjustable swing and latch speeds. Max 5lb opening force. Specify 90 DEGREE HOLD-OPEN or 105 DEGREE NON-HOLD.
    - 3) Tubular Pull: Stainless steel or matte black, lengths and diameter vary.
    - 4) Stop: Floor mounted Stainless with neoprene ring bumper.

E. Hush Series Full Height, Relocatable, Aluminum and Glass Partition System:

1. Single Glazed:
  - a. Glass: 3/8 inch (10 mm) clear tempered glass (polished on all edges) for partitions up to 7'-10” high.
    - 1) Frame: 3.125” wide x 1.75” high Channel to accommodate either single or double glazed partition with integral glazing seals. Requires either single or double glazed insert trim to finish profile.

F. Bottom and Wall Channels:

1. 2.875” wide x 1.25” high Channel to accommodate either single or double glazed partition with integral glazing seals. Requires either single or double glazed insert trim to finish profile.

G. Door Frames/Vertical Members/Horizontal Members:

1. Extruded aluminum Vertical Member with integral glass seals. 1 1/2” face x 3 1/8” depth.
2. Vertical Members to be placed at both sides of all doorways and vertical transitions to adjacent GWB partitions.

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3. Extruded aluminum Doorframe Support Channel screws into Vertical & Horizontal Members. Doorframe Support Channels are factory prepared to receive specified hinges & strike plates
4. Extruded aluminum Snap-in Doorframes with integral stop and sound seals
5. Additional vertical members may be placed at any location where a vertical divider is desired
6. Vertical Members require either Single Glazed Trim or Double Glazed Trim
7. Extruded aluminum horizontal member with integral glass seals. 1 3/8" high x 2 11/16" depth
8. Horizontal members to be placed at top and bottom of partition and any location where a horizontal divider is desired
9. Horizontal support members require a face trim on each side and either Single Glazed Trim or Double Glazed Trim

H. Wall Trim Panel:

1. Extruded aluminum channel to receive snap-on face trim with integral seals for glass & light & sound seal at wall (1 3/4" face x 2 5/8" wide).
2. Extruded aluminum snap on face trim channels.

I. Horizontal Mullion:

1. Extruded aluminum mullion (7/8" face dimension) adhered to glass with high bond tape

J. Glass Joints:

1. Translucent bonding tape (0.060 thickness), polycarbonate joint or extruded aluminum mullion.
2. Micro shim glass as required for proper alignment.

K. Finishes:

1. Aluminum: Clear anodized or matte black.
2. Stainless Steel Fittings: Satin finish.

## 2.3 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.4 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker over a mechanical finish.
- B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker over a mechanical finish.

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2.5 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes vertical for vertical surfaces and parallel to long dimension for framing.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  - 3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine components before installation. Reject components that are wet, moisture damaged, mold damaged, broken, cracked, chipped, deformed, or unmatched.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved Shop Drawings.
- B. Use anchorage devices to securely attach assembly to structure.
- C. Install demountable partitions after other finishing operations have been completed.
  - 1. Install partitions rigid, level, plumb, and aligned. Install seals at connections with floors, ceilings, fixed walls, and abutting surfaces to prevent light and sound transmission.
  - 2. Except for filler panels scribed to fixed walls or columns, do not modify manufacturer's standard components.
- D. Suspended-Ceiling System: Make alterations to suspended-ceiling system required by partition installation or to gain access to electrical or communication systems without affecting the structural integrity of suspended-ceiling system. Make alterations so they are not noticeable after panel installation.
- E. Doors and Frames: Install door-and-frame and glazing-and-glazing-frame assemblies securely anchored to partitions and with doors aligned and fitted. Install and adjust door hardware for proper operation.

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3.3 ERECTION TOLERANCES

- A. Install each demountable partition so surfaces have a maximum variation from plumb or level: 1/8 inch in 10 feet, maximum misalignment of members abutting end to end: 1/16 inch.

3.4 ADJUSTING

- A. Inspect installation, correct misalignments, and tighten loose connections.
- B. Doors: Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly, and lubricate as recommended by manufacturer. Verify that latches and locks engage accurately and securely without forcing or binding.
- C. Remove and replace defaced or damaged components that cannot be satisfactorily repaired.

3.5 PROTECTION

- A. Protect installed products until completion of project
- B. Touch-up, repair or replace damaged products before Substantial Completion
- C. Required safety marking/film is the responsibility of the customer

3.6 CLEANING

- A. After installation and adjusting clean metal and glass surfaces to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials.

END OF SECTION

SECTION 102239 – AUTOMATIC VERTICALLY RETRACTABLE ACOUSTICAL WALL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Automatic vertically retractable acoustical panel partitions.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
2. Section 092900 "Gypsum Board" for fire-rated assemblies and sound barrier construction above the ceiling at track.
3. Electrical and communications Sections for electrical service and connections for motor operators, controls, and limit switches and for system disconnect switches.

1.2 DEFINITIONS

A. NIC: Noise Isolation Class.

B. NRC: Noise Reduction Coefficient.

C. STC: Sound Transmission Class.

1.3 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. Operable acoustical panel partitions.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. Chain-of-Custody Qualification Data: For manufacturer and vendor.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: For operable panel partitions.

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1. Include plans, elevations, sections, attachment details, and numbered panel installation sequence.
  2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
  3. Include diagrams for power, signal, and control wiring.
- E. Delegated Design Submittals: For operable panel partitions.
1. Include design calculations for seismic restraints that brace tracks to structure above.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Partition track, track supports and bracing, switches, turning space, and storage layout.
  2. Suspended ceiling components.
  3. Structural members to which suspension systems will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. HVAC ductwork, outlets, and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Smoke detectors.
    - f. Access panels.
- C. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- D. Qualification Data: For Installer.
- E. Seismic Qualification Certificates: For operable panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, in accordance with ASCE/SEI 7.
  2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.
- F. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.
- G. Field quality-control reports.
- H. Sample Warranty: For manufacturer's special warranty.

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1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
    - b. Seals, hardware, track, track switches, carriers, and other operating components.
    - c. Electric operator and controls.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- C. The operable wall must be manufactured by a certified ISO-9001-2008 company or an equivalent quality control system.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of operable panel partitions.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Period:
    - a. The operable wall shall be warranted free from defects in material and workmanship for a period of two (2) years or five thousand (5,000) cycles, whichever occurs first, from the date of shipment.

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- b. The operable wall shall retain its acoustical properties for 10 years from the date of shipment providing proper maintenance has been performed on the partition.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 “Quality Requirements” to design seismic bracing of tracks to structure above.
- B. Seismic Performance: Operable panel partitions are to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
  - 1. The term "withstand" means "the partition panels will remain in place without separation of any parts when subjected to the seismic forces specified."
- C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties in accordance with test methods indicated:
  - 1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance in accordance with ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.
  - 2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance in accordance with ASTM C423, and rated for not less than the NRC indicated.
  - 3. Noise-Isolation Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC in accordance with ASTM E336, determined by ASTM E413, and rated for 10 dB less than STC value indicated.
- D. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 ELECTRIC OPERABLE ACOUSTICAL PANEL PARTITIONS

- A. Operable Acoustical Panel Partitions: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide “Zenith 48” vertical lifting operable wall, by Skyfold.



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- B. Panel Operation: Automatic vertically retractable acoustical wall, paired.
- C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- D. The operable wall shall open and close in a manner similar to an accordion, in that all wall panels fold and unfold sequentially in an accordion fashion.
- E. The operable wall shall stack in the up (open) position into a space no greater than 65" wide. The operable wall shall have a stacking height ratio in the range of 1:5 to 1:10, depending on the height of the wall.
- F. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
  - 1. Panel Width: All of the panels shall be rectangular, nominally of the same size.
- G. STC: Not less than System STC 48, Panel Construction STC 57.
- H. NRC: Not less than 0.50.
- I. Panel Weight: 6 lb/sq. ft. maximum.
- J. Panel Thickness: Nominal dimension of 11.75 inches.
- K. Panel Materials:
  - 1. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
  - 2. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard minimum nominal thickness for uncoated steel.
  - 3. Gypsum Board: ASTM C1396/C1396M.
  - 4. White marker board surface.
- L. Panel Closure: Manufacturer's standard unless otherwise indicated.
  - 1. Initial Closure: Resilient, bulb-shaped acoustical seal.
  - 2. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.
- M. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
- N. Finish Facing: Fabric wall covering and white marker board.
- O. Standard Drive System: Motor drive assembly is mounted directly above the center line of the operable wall.

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2.3 SEALS

- A. Description: Seals that produce operable panel partitions complying with performance requirements and the following:
  - 1. Manufacturer's standard seals unless otherwise indicated.
  - 2. Seals made from materials and in profiles that minimize sound leakage.
  - 3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Horizontal Top Seals: Continuous-contact, resilient seal exerting uniform constant pressure on ceiling.
- C. Horizontal Bottom Seals:
  - 1. The operable wall shall automatically and acoustically seal against the floor without the need for any manual intervention. The floor seals shall leave a joint between the floor and the bottom acoustical panels of not more than approximately 2 inches.
- D. Vertical Side Seals:
  - 1. The operable wall shall automatically and acoustically seal against the two end walls without the need for any manual intervention. The end seals shall act in such a way as not to come into contact with the end walls while the operable wall is in motion. The end seals shall leave a joint between the acoustical panels and the end walls of no more than approximately 1". Seals that rub or brush against the end walls are not acceptable. Once the operable wall reaches the full down position, the end seals shall activate automatically. The key switch does not need to be held during the deployment of the end seals.

2.4 PANEL FINISH FACINGS

- A. Description: Finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
  - 1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
- B. Fabric Wall Covering: Manufacturer's standard fabric, from same dye lot, treated to resist stains.
  - 1. Color/Pattern:
    - a. Basis-of-Design: Duvaltex Marin 1300 or Duvaltex Resolve 1301.
    - b. As selected by Architect from manufacturer's full range.

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- C. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

## 2.5 FOLDING MECHANISM

- A. The hanging, folding and extension mechanism shall be, as much as possible, made from structural grade aluminum extrusions and structural shapes, in order to minimize the weight of the system.
- B. All wear surfaces, such as bushings, spacers, pins, discs, bearings, and sleeves shall be designed to function quietly and with minimum wear, over the 10,000 cycle design life of the operable wall.
- C. The hangers, which fasten the lifting mechanism to the support steel, shall be fabricated from steel and shall be welded or bolted to the support steel supplied by others.

## 2.6 ELECTRIC OPERATORS

- A. Factory-assembled electric operation system of size and capacity recommended and provided by operable panel partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, control stations, control devices, and accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- B. Comply with NFPA 70.
- C. Control Equipment: Comply with NEMA ICS 1.
- D. Motor Electrical Characteristics:
  - 1. Horsepower: 1.27 HP
  - 2. Volts: 208 V
  - 3. Phase: 3 Phase
  - 4. Hertz: 60.
- E. Operator Switch Type: Push Buttons & Key Switch
- F. Obstruction-Detection Devices: Equip each motorized operable panel partition with indicated automatic safety sensor that causes operator to immediately stop and reverse direction.
- G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.
- H. The operable wall shall employ an over torque detector in order to sense a jam in the system and to act as an over travel limit in the up direction should the primary limit switch fail to act in 1.3.2.4. This over torque sensor shall be mechanical, using the motor's torque arm in its over torque detection.

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2.7 ACCESSORIES

- A. Work Surfaces: Quantities, placement, and size indicated.
  - 1. Surface: Porcelain steel marker/projection surface
  - 2. Surface Color: White
  - 3. Size: Full width and height of panel as indicated on drawings

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
  - 1. The floor underneath the wall along its axis must be flat to within 14" over the entire length of the wall. A peak to valley undulation of  $\pm 14"$  must not be closer together than 24" . A peak to valley undulation of  $\pm 18"$  must not be closer together than 12".
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF OPERABLE PANEL PARTITIONS

- A. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- B. Install panels in numbered sequence indicated on Shop Drawings.
- C. Install operable walls in accordance with the manufacturer's printed instructions.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

3.3 ADJUSTING

- A. Adjust and fine-tune the operable walls to ensure that all seals are operating and sealing properly and that the operable walls are in correct and smooth operation.
- B. Verify that safety devices are properly functioning.

END OF SECTION

## SECTION 102600 - WALL AND DOOR PROTECTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Corner guards.
  - 2. Abuse-resistant wall coverings.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- C. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
  - 3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- D. Shop Drawings: For each type of wall and door protection showing locations and extent.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Material Certificates: For each type of exposed plastic material.
- C. Sample Warranty: For special warranty.

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1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
  - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store wall protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  - 1. Maintain room temperature within storage area at not less than 65 deg F during the period plastic materials are stored.
  - 2. Keep plastic materials out of direct sunlight.
  - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 65 deg F.
    - a. Store corner-guard covers in a vertical position.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
  - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 450 or less.

## 2.3 CORNER GUARDS

- A. Surface-Mounted, Plastic-Cover Corner Guards CG-1: Manufacturer's standard, PVC-free assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
1. Basis-of-Design Product: Subject to compliance with requirements, provide EnviroGT-160R by Inpro Corp, or comparable product by one of the following:
    - a. Construction Specialties, Inc.
    - b. Korogard Wall Protection Systems; a division of RJF International Corporation.
    - c. Nystrom, Inc.
  2. Cover: Extruded rigid plastic, minimum 0.08-inch wall thickness; as follows: in dimensions and profiles indicated on Drawings.
    - a. Profile: Nominal 2-inch-long leg and 1/4-inch corner radius.
    - b. Height: 4 feet.
    - c. Color and Texture: As selected by Architect from manufacturer's full range to match wall paint locations.
  3. Continuous Retainer: 0.075-inch-thick, one-piece, extruded biobased plastic polymer.
  4. Retainer Clips: Manufacturer's standard impact-absorbing clips.
  5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
- B. Surface-Mounted, Stainless Steel Corner Guards CG-2: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Construction Specialties, Inc.
    - b. Korogard Wall Protection Systems; a division of RJF International Corporation.
    - c. Nystrom, Inc.
    - d. inpro Corporation.
  2. Material: Stainless-steel sheet, Type 304.
    - a. Thickness: Minimum 0.0625-inch.
    - b. Finish: Directional satin, No. 4.

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3. Material: 16 gauge stainless steel.
4. Wing Size: Nominal 2 by 2 inches.
5. Corner Radius: 1/8 inch.
6. Mounting: Adhesive.

## 2.4 ABUSE-RESISTANT WALL COVERINGS

- A. Abuse-Resistant Sheet Wall Covering WP: Fabricated from semi-rigid, plastic sheet wall-covering material.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Puraguard by Altro, or comparable product by one of the following:
    - a. Construction Specialties, Inc.
    - b. Korogard Wall Protection Systems; a division of RJF International Corporation.
    - c. inpro Corporation.
  2. Size: 48 by 96 inches.
  3. Sheet Thickness: 0.080 inch.
  4. Color and Texture: As selected by Architect from manufacturer's full range.
  5. Height: 8 foot and 8-inches.
  6. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
  7. Mounting: Adhesive.

## 2.5 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D256, Test Method A.
- C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- D. Adhesive: As recommended by protection product manufacturer.
  1. Verify adhesives have a VOC content of 48 g/L or less.
  2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.6 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.



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- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.7 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  - 1. For wall protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

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1. Provide anchoring devices and suitable locations to withstand imposed loads.
  2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
  3. Adjust end and top caps as required to ensure tight seams.
- C. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

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SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Childcare accessories.
4. Underlavatory guards.
5. Custodial accessories.

B. Related Requirements:

1. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  3. Include electrical characteristics.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  1. Identify locations using room designations indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, visible silver spoilage defects.
  - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Design accessories and fasteners to comply with the following requirements:
  - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
  - 2. Shower Seats: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser :
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick, B-4288 toilet tissue dispenser, or comparable product by one of the following:
    - a. ASI-American Specialties, Inc.
    - b. Bradley Corporation
    - c. Brey-Krause Manufacturing Co.
    - d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - 2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
  - 3. Mounting: Surface mounted.

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4. Operation: Spindleless with tension-spring controlled delivery and self-locking device extending through core that prevents core removal until roll is empty.
5. Capacity: Designed for 5-inch-diameter tissue rolls.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Automatic Paper Towel (Roll) Dispenser :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick, B-2974 Surface-Mounted Automatic Roll Paper Towel Dispenser, or comparable product by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bradley Corporation
  - c. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
2. Description: Automatic motion-sensing mechanism with user-adjustable delay and paper towel length; battery powered.
3. Mounting: Surface mounted.
4. Minimum Capacity: 8-inch-wide, 800-foot-long roll.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
6. Lockset: Tumbler type.

D. Combination Towel (Roll) Dispenser/Waste Receptacle :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick, B3974 Recessed Convertible Auto Roll Towel Dispenser/Waste Receptacle, or comparable product by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bradley Corporation
  - c. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
2. Description: Combination unit for dispensing preset length of roll paper towels, with removable waste receptacle.
3. Towel Mechanism: Automatic, battery-operated sensor.
4. Mounting: Semirecessed.
5. Minimum Towel-Dispenser Capacity: 8-inch-wide, 800-foot-long roll.
6. Minimum Waste Receptacle Capacity: 12 gal.
7. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
8. Liner: Reusable, vinyl waste-receptacle liner.
9. Lockset: Tumbler type for towel dispenser compartment.

E. Automatic Soap Dispenser :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick, B-2012 Surface-Mounted Automatic Liquid Soap Dispenser, or comparable product by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - c. Sloan Valve Company

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2. Description: Automatic dispenser with infrared sensor to detect presence of hands; battery powered; designed for dispensing soap in liquid form.
3. Mounting: Surface mounted.
4. Capacity: 30 oz.
5. Materials: Type 304, 18-gauge stainless steel with satin finish.
6. Refill Indicator: LED indicator.
7. Low-Battery Indicator: LED indicator.

F. Grab Bar :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc
  - c. Bradley Corporation
  - d. Brey-Krause Manufacturing Co.
  - e. Construction Solutions
  - f. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - g. Oatey Co.
  - h. ProFlo; a Ferguson Enterprises, Inc. brand
  - i. Seachrome Corporation
  - j. Tubular Specialties Manufacturing, Inc.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. OD: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings.

G. Mirror Unit :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick, B-290 Glass Mirror with stainless steel angle frame, or comparable product by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bradley Corporation
  - c. Brey-Krause Manufacturing Co.
  - d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
2. Frame: Stainless steel angle, 0.05 inch thick.
  - a. Corners: Welded and ground smooth.
3. Size: 24 inches by 42 inches.

H. Hook :

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1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick, B-76727, Surface-Mounted Double Robe Hook, or comparable product by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bradley Corporation
  - c. Brey-Krause Manufacturing Co.
  - d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
2. Description: Double-prong unit.
3. Mounting: Concealed.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

- A. Source Limitations: Obtain public-use shower room accessories from single source from single manufacturer.
- B. Heavy-Duty Shower Curtain Rod :
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASI-American Specialties, Inc.
    - b. Bobrick Washroom Equipment, Inc
    - c. Bradley Corporation
    - d. Brey-Krause Manufacturing Co.
    - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  2. Description: 1-inch-OD, straight rod.
  3. Configuration: As indicated on Drawings.
  4. Mounting Flanges: Concealed fasteners; in material and finish matching rod.
  5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  6. Rating: Heavy-duty.
- C. Shower Curtain :
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASI-American Specialties, Inc.
    - b. Bobrick Washroom Equipment, Inc
    - c. Bradley Corporation
    - d. Brey-Krause Manufacturing Co.
    - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  2. Size: Minimum 42 inches by 72 inches high.
  3. Material: Nylon-reinforced vinyl, minimum 9 oz. or 0.008-inch-thick vinyl, with integral antibacterial and flame-retardant agents.
  4. Color: White.
  5. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.

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6. Shower Curtain Hooks: Stainless steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

## 2.4 CHILDCARE ACCESSORIES

- A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.

- B. Diaper-Changing Station :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Koala, KB310-SSWM Horizontal Stainless Steel Surface-Mounted, or comparable product by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bradley Corporation
  - c. Diaper Deck & Co.
  - d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - e. Koala Kare Products; Bobrick Washroom Equipment, Inc.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
  - a. Engineered to support minimum of 200 lb static load when opened.
3. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin), with replaceable insulated polypropylene tray liner with microban antimicrobial product and rounded plastic corners.
6. Liner Dispenser: Provide built-in dispenser for disposable sanitary liners.

## 2.5 UNDERLAVATORY GUARDS

- A. Underlavatory Guard :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Buckaroos, Inc.
  - b. Plumberex Specialty Products, Inc.
  - c. Truebro; IPS Corporation
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.



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2.6 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Custodial Utility Shelf :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Advance Tabco WE-12-36, or comparable product by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc
  - c. Brey-Krause Manufacturing Co.
  - d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
2. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
3. Size: 36 inches long by 12 inches deep.
4. Material and Finish: Not less than nominal 0.05-inch-thick stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Custodial Mop and Broom Holder :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley, 9934 Utility Shelf, 5 Hooks/4 Holders, or comparable product by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc
  - c. Brey-Krause Manufacturing Co.
  - d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 34 inches wide by 13.75 inches deep.
4. Hooks: Five.
5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  - a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.

2.7 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.

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- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.8 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION OF TOILET, BATH, AND LAUNDRY ACCESSORIES

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
  - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION

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SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Fire-protection cabinets for the following:
    - a. Portable fire extinguishers.
- B. Related Requirements:
  - 1. Section 104416 "Fire Extinguishers."

1.3 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to fire-protection cabinets including, but not limited to, the following:
    - a. Schedules and coordination requirements.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
  - 1. Show location of knockouts for hose valves.
- C. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- D. Samples: For each type of exposed finish required.

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- E. Samples for Initial Selection: For each type of exposed finish required.
- F. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches square.
- G. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.6 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers and fire hose valves indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.7 SEQUENCING

- A. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher and extinguisher and hose valve.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fire-End & Croker Corporation.

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- b. [GMR International Equipment Corporation.](#)
- c. [Guardian Fire Equipment, Inc.](#)
- d. [JL Industries, Inc.; a division of the Activar Construction Products Group.](#)
- e. [Larsens Manufacturing Company.](#)
- f. [Modern Metal Products, Division of Technico Inc.](#)
- g. [MOON American.](#)
- h. [Nystrom, Inc.](#)
- i. [Potter Roemer LLC.](#)
- j. [Strike First Corporation of America \(The\).](#)

B. Cabinet Construction: 1-hour fire rated.

- 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- thick cold-rolled steel sheet lined with minimum 5/8-inch- thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Cold-rolled steel sheet.

- 1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet:

- 1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as drywall bead.
- 2. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

- 1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

F. Cabinet Trim Material: Steel sheet.

G. Door Material: Steel sheet.

H. Door Style: Vertical duo panel with frame.

I. Door Glazing: Tempered float glass (clear).

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

- 1. Provide manufacturer's standard.
- 2. Provide concealed hinge permitting door to open 180 degrees.

K. Accessories:

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1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
  - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
    - 1) Location: Applied to cabinet door.
    - 2) Application Process: Pressure-sensitive vinyl letters.
    - 3) Lettering Color: White.
    - 4) Orientation: Vertical.

L. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
  - a. Finish: Baked enamel or powder coat.
  - b. Color: As selected by Architect from full range of industry colors and color densities.
2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
  1. Weld joints and grind smooth.
  2. Provide factory-drilled mounting holes.
  3. Prepare doors and frames to receive locks.
  4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
  1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  2. Fabricate door frames of one-piece construction with edges flanged.
  3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

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2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for hose valves and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
  - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
  - 2. Provide inside latch and lock for break-glass panels.
  - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
  - 4. Fire-Rated Hose-Valve Cabinets:
    - a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
    - b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

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- C. Identification: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION



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SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
  - 1. Section 104413 "Fire Protection Cabinets."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
    - a. Schedules and coordination requirements.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Warranty: Sample of special warranty.

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1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.7 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amerex Corporation.
    - b. Ansul Incorporated; Tyco International.

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- c. [Babcock-Davis.](#)
  - d. [Badger Fire Protection.](#)
  - e. [Buckeye Fire Equipment Company.](#)
  - f. [Fire End & Croker Corporation.](#)
  - g. [Guardian Fire Equipment, Inc.](#)
  - h. [JL Industries, Inc.; a division of the Activar Construction Products Group.](#)
  - i. [Kidde Residential and Commercial Division.](#)
  - j. [Larsens Manufacturing Company.](#)
  - k. [MOON American.](#)
  - l. [Nystrom, Inc.](#)
  - m. [Potter Roemer LLC.](#)
  - n. [Pyro-Chem; Tyco Fire Suppression & Building Products.](#)
  - o. [Strike First Corporation of America \(The\).](#)
2. Valves: Manufacturer's standard.
  3. Handles and Levers: Manufacturer's standard.
  4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Wet-Chemical Type: UL-rated 2-A:1-B:C:K, 2.5-gal. nominal capacity, with potassium acetate, citrate, or carbonate-based chemical in stainless-steel container; with pressure-indicating gage.
- C. Regular Dry-Chemical Type in Steel Container: UL-rated 10-B:C, 5-lb nominal capacity, with sodium bicarbonate-based dry chemical in enameled-steel container.
- D. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 3-A:40-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

## 2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
    - a. [Amerex Corporation.](#)
    - b. [Ansul Incorporated; Tyco International.](#)
    - c. [Babcock-Davis.](#)
    - d. [Badger Fire Protection.](#)
    - e. [Buckeye Fire Equipment Company.](#)
    - f. [Fire End & Croker Corporation.](#)
    - g. [Guardian Fire Equipment, Inc.](#)
    - h. [JL Industries, Inc.; a division of the Activar Construction Products Group.](#)
    - i. [Kidde Residential and Commercial Division.](#)
    - j. [Larsens Manufacturing Company.](#)
    - k. [Nystrom, Inc.](#)
    - l. [Potter Roemer LLC.](#)
    - m. [Pyro-Chem; Tyco Fire Suppression & Building Products.](#)

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n. Strike First Corporation of America (The).

- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
  - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

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SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Knocked-down athletic lockers.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.

C. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.

D. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

B. Qualification Data: For Installer.

C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

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- B. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate sizes and locations of wood bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Faulty operation of latches and other door hardware.
  - 2. Damage from deliberate destruction and vandalism is excluded.
  - 3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain metal lockers and accessories from single source from single locker manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design".

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2.3 KNOCKED-DOWN ATHLETIC LOCKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASI Storage Solutions.
  2. Art Metal Products.
  3. GSS Lockers.
  4. Hadrian Inc.; Zurn Industries, LLC.
  5. List Industries Inc.
  6. LockersMFG.
  7. Lyon LLC.
  8. Olympus Lockers & Storage Products, Inc.
  9. Penco Products, Inc.
  10. Republic Storage Systems, LLC.
  11. Top Tier Storage Products.
  12. WEC Manufacturing LLC.
- B. Perforated Doors: One piece; fabricated from 0.075-inch nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges and latch point (bottom) and right-angle single bend at remaining edges for box lockers.
1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
- C. Expanded-Metal Doors: Fabricated from 0.090-inch nominal-thickness expanded metal; welded to 0.105-inch nominal-thickness steel angle frame; with 0.090-inch nominal-thickness, steel sheet lock panel backed by 0.060-inch nominal-thickness, steel sheet retainer welded to door frame.
- D. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
1. Tops and Bottoms: 0.060-inch nominal thickness, with single bend at edges.
  2. Backs: 0.048-inch nominal thickness.
  3. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.
- E. Unperforated Sides: Fabricated from 0.060-inch nominal-thickness steel sheet.
- F. Perforated Sides: Fabricated from 0.060-inch nominal-thickness steel sheet with manufacturer's standard diamond perforations.
- G. Expanded-Metal Sides: Fabricated from 0.090-inch nominal-thickness expanded metal; welded to 0.105-inch nominal-thickness steel angles or 0.060-inch nominal-thickness steel channel frames.
- H. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet or 0.097-inch nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

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1. Cross Frames for Double-Tier Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
  2. Cross Frames for Triple-Tier Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
- I. Reinforced Bottoms: Structural channels, formed from 0.075-inch nominal-thickness steel sheet; welded to front and rear of side-panel frames.
- J. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; self-closing.
1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches high. Provide no fewer than three hinges for each door more than 42 inches high.
  2. Continuous Hinges: Manufacturer's standard, steel; side or top mounted as required by locker configuration.
  3. Hinges: Manufacturer's standard, steel, continuous or knuckle type.
- K. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic latching and prelocking.
    - a. Latch Hooks: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.120-inch nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
    - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
  2. Single-Point Latching: Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock.
    - a. Latch Hook: Equip each door with one latch hook, fabricated from 0.120-inch nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.
- L. Projecting Turn-Handle and Latch: Steel handle welded to manufacturer's standard, three-point, cremone-type latching mechanism consisting of steel rods or bars that engage locker frame at top and bottom of door, and center latch that engages strike jamb; with steel padlock loop.
- M. Door Handle and Latch for Box Lockers: Stainless steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.
- N. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum or plastic plates, with numbers and letters at least 3/8 inch high.
- O. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.



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- P. Legs: 6 inches high; formed by extending vertical frame members, or fabricated from 0.075-inch nominal-thickness steel sheet; welded to bottom of locker.
  - 1. Closed Front and End Bases: Fabricated from 0.048-inch nominal-thickness steel sheet.
- Q. Continuous Zee Base: 4 inches high; fabricated from 0.075-inch nominal-thickness steel sheet.
- R. Boxed End Panels: Fabricated from 0.060-inch nominal-thickness steel sheet.
- S. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- T. Materials:
  - 1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
  - 2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.
  - 3. Expanded Metal: ASTM F1267, Type II (flattened), Class I (uncoated), 3/4-inch steel mesh, with at least 70 percent open area.
- U. Finish: Baked enamel or powder coat.
  - 1. Color: As selected by Architect from manufacturer's full range.

## 2.4 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
  - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
  - 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- C. Equipment: Provide each locker with an identification plate and the following equipment:
  - 1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
- D. Knocked-Down Construction: Fabricate metal lockers by assembling at Project site, using manufacturer's nuts, bolts, screws, or rivets.
- E. Accessible Lockers: Fabricate as follows:
  - 1. Locate bottom shelf no lower than 15 inches above the floor.
  - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

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- F. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.
- G. Boxed End Panels: Fabricated with 1-inch-wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
  - 1. Provide one-piece panels for double-row (back-to-back) locker ends.
- H. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- I. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.5 ACCESSORIES

- A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- B. Anchors: Material, type, and size required for secure anchorage to each substrate.
  - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
  - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lockers level, plumb, and true; shim as required, using concealed shims.
  - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
  - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
- B. Knocked-Down Lockers: Assemble with manufacturer's standard fasteners, with no exposed fasteners on door faces or face frames.

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C. Equipment:

1. Attach hooks with at least two fasteners.
2. Identification Plates: Identify metal lockers with identification indicated on Drawings.
  - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
  - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

3.4 PROTECTION

- A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

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SECTION 107516 - GROUND-SET FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes ground-set flagpoles made from aluminum.
- B. Owner-Furnished Material: Flags.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

1.3 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

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2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Flagpole assemblies to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Structural Performance: Flagpole assemblies, including anchorages and supports, to withstand design loads indicated within limits and under conditions indicated.
  - 1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is 110 mph.
  - 2. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

2.3 ALUMINUM FLAGPOLES

- A. Aluminum Flagpoles: Cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Acme Lingo Flagpoles.
    - b. American Flagpole.
    - c. Baartol Company.
    - d. Concord American Flagpole.
    - e. Eder Flag Manufacturing Company, Inc.
    - f. Ewing Flagpole Co., Inc.; Ewing Group Company.
    - g. Flagpole Warehouse.
    - h. Morgan-Francis Flagpoles and Accessories.
    - i. Pole-Tech Co., Inc.
    - j. US Flag & Flagpole Supply, LLC.
- B. Exposed Height: 25 feet.
- C. Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:
  - 1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
  - 2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.
- D. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch wall thickness with 3/16-inch steel bottom plate and support plate; 3/4-inch-diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.
  - 1. Flashing Collar: Same material and finish as flagpole.

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2.4 FITTINGS

- A. Internal Halyard, Cam Cleat System: 3/8-inch-diameter, braided polypropylene halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
  - 1. Halyard Flag Snaps: Stainless steel swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.
  - 2. Flagpole Beacon Light: Internal halyard compatible, aluminum, flagpole-top light featuring two HD LED bulbs (120V each) and internal 359 degree revolving truck.
    - a. Color: Match material and finish of flagpole.

2.5 MISCELLANEOUS MATERIALS

- A. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.
- B. Sand: ASTM C33/C33M, fine aggregate.
- C. Elastomeric Joint Sealant: Multicomponent nonsag urethane joint sealant complying with requirements in Section 079200 "Joint Sealants."
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 ALUMINUM FINISHES

- A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.
- B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.
- C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.
- D. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

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- E. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.
- F. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

- A. General: Install flagpoles where indicated and according to manufacturer's written instructions.
- B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION

## SECTION 122413 - ROLLER WINDOW SHADES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Manually operated, single-roller shades.
2. Motor-operated, double-roller shades.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 260010 "Supplemental Requirements for Electrical" for additional requirements applicable to coordinating, scheduling, and sequencing of the electrical Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. For each type of product.
  - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - b. Include rated capacities, operating characteristics, electrical characteristics, features, and furnished accessories.

C. Shop Drawings:

1. Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
2. Motor-Operated Shades: Include diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type and color of shadeband material and for each type of exposed finish.

1. Include Samples of accessories involving color selection.

E. Product Schedule: For roller shades. Use same designations indicated on Drawings.



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F. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating percentage of postconsumer and preconsumer recycled content and cost.
2. Laboratory Test Reports: For product, indicating compliance with requirements for low-emitting materials.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Certificates: For each type of shadeband material.
- C. Qualification Statements: For Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For roller shades.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Roller Shades: Full-size units equal to two units for each size, color, and shadeband material indicated. Include mounting hardware.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.7 MOCKUPS

- A. Install one of each type of roller window shade as a mockup to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  1. Approval of mockups does not constitute approval of deviations from the Contract Doc-

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uments contained in mockups unless Owner specifically approves such deviations by Change Order.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of products that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Defects in materials and workmanship beyond normal wear and tear.
    - b. Faulty operation of operating system components.
    - c. Deterioration of fabric beyond normal use.
  2. Warranty Period:
    - a. Roller Window Shades: 25 year(s) from date of Substantial Completion.
    - b. Motorized Components: 10 year(s) from date of Substantial Completion.
    - c. Fabric: 25 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain roller shades from single source from single manufacturer.

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2.2 PERFORMANCE REQUIREMENTS

- A. Window Covering Safety Standard: Provide roller window shades that comply with WCMA A100.1.
- B. Fire Performance: Tested in accordance with and meeting the flame propagation performance criteria of Test 1 or Test 2, as appropriate, of NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
  - 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
    - a. Drapery Operators: UL CCN FDDR, including UL 325.
- D. Accessibility Standards: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" for roller window shades designated as accessible.
- E. Laboratory Test Reports: For product, indicating compliance with requirements for low-emitting materials.
- F. Product Data: For product, indicating compliance with requirements for formaldehyde emissions.

2.3 MANUALLY OPERATED ROLLER WINDOW SHADES (WS-1)

- A. Manually Operated, Single-Roller Shades : For interior use in rectangular openings.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "Urban Shade," by MechoShade Systems, or comparable product by one of the following:
    - a. Draper, Inc.
    - b. Hunter Douglas Architectural Window Coverings
    - c. Insolroll Window Shading Systems
    - d. Levolor Inc.
    - e. Lutron Electronics Co., Inc
    - f. Springs Window Fashions; SWFcontract
  - 2. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
    - a. Roller Drive-End Location: Right side of interior face of shade.

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- b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
  - c. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.
- 3. Shadebands:
  - a. Shadeband Material: Light-filtering fabric.
  - b. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - 1) Type: Manufacturer's standard exposed bottom bar with integral light seal.
    - 2) Color and Finish: As selected by Architect from manufacturer's full range.
- 4. Mounting Hardware: Brackets or endcaps, with endcap covers where exposed, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and installation location and conditions indicated.
- 5. Installation Accessories:
  - a. Front Fascia: Aluminum extrusion that conceals front and underside of roller and shadeband assembly and attaches to roller endcaps without exposed fasteners.
    - 1) Shape: L-shaped.
    - 2) Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 3 inches.
  - b. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 MOTOR-OPERATED ROLLER WINDOW SHADES (WS-2)

- A. Motor-Operated, Double-Roller Shades: For interior use in rectangular openings.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide “Urban Shade, Dual Electric Shade” by MechoShade Systems, or comparable product by one of the following:
    - a. Draper, Inc.
    - b. Hunter Douglas Architectural Window Coverings
    - c. Insolroll Window Shading Systems
    - d. Lutron Electronics Co., Inc
    - e. MechoShade Systems, LLC
    - f. Springs Window Fashions; SWFcontract
  - 2. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
    - a. Double-Roller Mounting Configuration: Offset, outside roller over and inside roll-

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- er under.
  - b. Inside Roller:
    - 1) Drive-End Location: Right side of interior face of shade.
    - 2) Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
  - c. Outside Roller:
    - 1) Drive-End Location: Right side of interior face of shade.
    - 2) Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
  - d. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.
- 3. Inside Shadebands:
  - a. Shadeband Material: Light-filtering fabric.
  - b. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - 1) Type: Flat slat enclosed in sealed pocket of shadeband material.
    - 2) Color and Finish: As selected by Architect from manufacturer's full range.
- 4. Outside Shadebands:
  - a. Shadeband Material: Light-blocking fabric.
  - b. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - 1) Type: Flat slat enclosed in sealed pocket of shadeband material.
    - 2) Color and Finish: As selected by Architect from manufacturer's full range.
- 5. Mounting Hardware: Double roller brackets or endcaps, with endcap covers where exposed, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation location and conditions indicated.
- 6. Installation Accessories:
  - a. Double Roller Front Fascia: Aluminum extrusion that conceals front and underside of rollers and shadeband assemblies and attaches to double roller endcaps without exposed fasteners.
    - 1) Shape: L-shaped.
    - 2) Height: Manufacturer's standard height required to conceal rollers and shadeband assemblies when shades are fully open.
- 7. Installation Accessories Color and Finish: As selected from manufacturer's full range.

## 2.5 MANUAL OPERATION

### A. Manual Corded Operation:

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1. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
  - a. Bead Chains: Stainless steel bead chain with WCMA A100.1 compliant tension device installed on roller window shade by manufacturer and mounted on wall.
    - 1) Loop Length: Full length of roller shade.
    - 2) Limit Stops: Provide upper and lower ball stops.
  - b. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
    - 1) Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

2.6 MOTORIZED OPERATION

- A. Motorized Operating Systems: Factory-assembled, motorized roller window shades with shade-operator system of size and capacity and with features, characteristics, and accessories required for conditions indicated, complete with motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for complete operation. For wired controls, include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- B. Type:
  1. Intelligent Motor with Wired Controls: Roller window shade manufacturer's standard tubular intelligent motor to suit conditions indicated, enclosed in roller. Intelligent motors and controls each with individual IP addresses, communicating together with two-way communication, and connected into a digital network A/V system.
    - a. Motor Electrical Characteristics: 120-V ac.
    - b. Motor Functions:
      - 1) Quiet Operation Motor: 120-V ac.
    - c. Network Functions:
      - 1) Integrate with third-party audiovisual (A/V). A/V System will send signal to shade motor to open/close.
    - d. Controls:
      - 1) A/V System will send signal to shade motor to open/close.
- C. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.

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- D. Maximum Total Shade Width: As required to operate roller shades indicated.
- E. Maximum Shade Drop: As required to operate roller shades indicated.
- F. Maximum Weight Capacity: As required to operate roller shades indicated.

2.7 SHADEBAND MATERIALS

- A. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
  - 1. Source: Roller shade manufacturer. Basis-of-Design: Ecoveil 1750 Series, MechoShade Systems.
  - 2. Type: Thermoplastic Olefin (TPO).
  - 3. Weave: Basketweave.
  - 4. Thickness: 0.0358 in.
  - 5. Weight: 14.51 oz./sq. yd.
  - 6. Roll Width: 26 inches.
  - 7. Orientation on Shadeband: Up the bolt.
  - 8. Openness Factor: 1 percent.
  - 9. Color: As selected by Architect from manufacturer's full range.
- B. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.
  - 1. Source: Roller shade manufacturer. Basis of Design: EcoGlass Blackout 2820 Series, MechoShade Systems.
  - 2. Type: Fiberglass with acrylic flocked backing.
  - 3. Thickness: 0.019 in.
  - 4. Weight: 14.75 oz./sq. yd..
  - 5. Roll Width: 126 inches.
  - 6. Orientation on Shadeband: Up the bolt.
  - 7. Color: As selected by Architect from manufacturer's full range.

2.8 FABRICATION OF ROLLER WINDOW SHADES

- A. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
  - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
- B. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION OF ROLLER WINDOW SHADES

- A. Install roller shades level, plumb, aligned and centered on openings, and aligned with adjacent units in accordance with manufacturer's written instructions.
  - 1. Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Roller Shade Locations: As indicated on Finish Schedule AE640.
- C. Electrical:
  - 1. Connect motor-operated roller window shades to building electrical system.
  - 2. Comply with manufacturer's written installation instructions.

#### 3.3 ADJUSTING

- A. Adjust and balance roller window shades to operate smoothly, easily, safely, and free from binding or malfunction through full operational range.

#### 3.4 CLEANING AND PROTECTION

- A. Clean roller window shade surfaces, after installation, in accordance with manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller window shades are without damage or deterioration at time of Substantial Completion.
- C. Protect electrical and communications wiring, cabling, raceways, and boxes, after installation. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use, before time of substantial completion.
- D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.



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3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller window shades.

END OF SECTION

SECTION 123553.16 - PLASTIC-LAMINATE-CLAD LABORATORY CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad laboratory casework.
2. Countertops.
3. Laboratory accessories.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring laboratory casework.
2. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring laboratory casework.
3. Section 096513 "Resilient Base and Accessories" for resilient base applied to laboratory casework.
4. Section 115313 "Laboratory Fume Hoods" for fume hoods, including base cabinets and countertops under fume hoods.
5. Section 224200 "Commercial Plumbing Fixtures" for undermount laboratory sinks.

1.2 DEFINITIONS

- A. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.
- B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and visible surfaces in open cabinets or behind glass doors.
1. Ends of cabinets are defined as "exposed" except ends are defined as "concealed" where installed directly against and completely concealed by walls or other cabinets.
- C. Plastic Laminate: High-Pressure Decorative Laminate (HPDL).
- D. Semiexposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cases 78 inches or more above floor and bottoms of cabinets more than 24 inches, but less than 48 inches above floor, are defined as "semiexposed."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

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1.4 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.
- B. Coordinate installation of laboratory casework with installation of laboratory equipment.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data:
  - 1. Plastic-laminate-clad laboratory casework.
  - 2. Auxiliary cabinets.
  - 3. Countertops.
  - 4. Laboratory accessories.
  - 5. Water and laboratory gas service fittings.
- C. Sustainable Design Submittals:
  - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
  - 2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
  - 3. Chain-of-Custody Qualification Data: For manufacturer and vendor.
  - 4. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
  - 5. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
- D. Shop Drawings: For laboratory casework.
  - 1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
  - 2. Indicate types and sizes of casework.
  - 3. Indicate manufacturer's catalog numbers for casework.
  - 4. Show fabrication details, including types and locations of hardware.
  - 5. Indicate locations and types of service fittings.
  - 6. Include details of exposed conduits, if required, for service fittings.
  - 7. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and laboratory equipment.
  - 8. Include coordinated dimensions for laboratory equipment specified in other Sections.
- E. Keying Schedule: Include schematic keying diagram, and index each key set to unique designations that are coordinated with the Contract Documents.

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1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For manufacturer.
- C. Product Test Reports: For countertop surface material, based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface material with requirements specified for chemical and physical resistance.

1.7 QUALITY ASSURANCE

- A. Manufacturer: Provide products certified as meeting or exceeding ANSI-A 161.1-2000 testing standards.
- B. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.
- C. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet-work are complete, and HVAC system is operating and stabilized for at least one week and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Established Dimensions: Where laboratory casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.
- D. Conditions: Do not install casework until interior concrete work, masonry, plastering, and other wet operations are complete.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.
- B. Obtain countertops, sinks, accessories, and service fittings from casework manufacturer.
- C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with the Specifications may be considered. See Section 016000 "Product Requirements."

2.2 CASEWORK, GENERAL

- A. Casework Product Standard: Comply with SEFA 8-PL, "Laboratory Grade Plastic Laminate Casework."
- B. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements in NFPA 30 by FM Approvals.
- C. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

2.3 PLASTIC-LAMINATE-CLAD LABORATORY CASEWORK

- A. Basis-of-Design Product: Subject to compliance with requirements, provide TMI Systems Corporation, Plastic Laminate Laboratory Cabinets, or comparable product by one of the following:
  - 1. Labscape.
  - 2. Mott Manufacturing.
  - 3. Stevens Industries, Inc.
- B. Design:
  - 1. Flush overlay.
- C. Grain Direction for Wood Grain Plastic Laminate:
  - 1. Doors: Vertical with continuous vertical matching.
  - 2. Drawer Fronts: Vertical with continuous vertical matching.
  - 3. Face Frame Members: Lengthwise.
  - 4. End Panels: Vertical.
  - 5. Bottoms and Tops of Units: Side to side.
  - 6. Knee Space Panels: Vertical.
  - 7. Aprons: Horizontal.

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D. Exposed Materials:

1. Plastic-Laminate Grade: HGS. Chemical Resistant decorative laminate, NEMA test LD 3-2005.
  - a. Colors and Patterns: As selected by Architect from manufacturer's full range.
2. Edgebanding: PVC.
  - a. PVC Edgebanding Color: As selected by Architect from casework manufacturer's full range.

E. Semiexposed Materials:

1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.
  - a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.

F. Concealed Materials:

1. Solid Wood: With no defects affecting strength or utility.
2. Plywood: Hardwood plywood.
3. Plastic Laminate: Grade VGS.
4. Particleboard.
5. MDF.
6. Hardboard.

2.4 PLASTIC-LAMINATE CABINET MATERIALS

- A. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
- B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.
- C. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
  1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. MR Moisture Resistant Particleboard: Average 45-pound density particleboard, ANSI A208.1 1-2009, M-2 Requirements.
- E. Particleboard: ANSI A208.1, Grade M-2.
  1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

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- F. Hardboard: ANSI A135.4, Class 1 tempered.
  - 1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- G. Plastic Laminate: Chemical-resistant decorative laminate, NEMA Test LD 3-2005.
- H. PVC Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3.0 mm thick at doors and drawer fronts, 1.0 mm thick elsewhere.
- I. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper.
  - 1. Edgebanding for Thermally Fused Laminate (TFL) Panels: PVC edgebanding matching thermally fused laminate panels.
  - 2. TFL allowed on casework interiors only, as specified below. Utilization of TFL on any exterior casework surfaces, including door and drawer faces and finished ends, will not be permitted.
- J. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 CABINET HARDWARE

- A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Butt Hinges: Stainless steel, five-knuckle hinges complying with ANSI/BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two for doors 48 inches high or less and three for doors more than 48 inches high.
- C. Hinged-Door and Drawer Pulls: Antimicrobial-coated, back-mounted pulls. Provide two pulls for drawers more than 24 inches wide.
  - 1. Design: ADA Compliant, as selected from manufacturer's full range.
  - 2. Overall Size: Manufacturer's standard.
  - 3. Antimicrobial coating to meet US-EPA antimicrobial regulatory approval.
- D. Door Catches: Dual, self-aligning, permanent magnet catches. Provide two catches on doors more than 48 inches high.
- E. Drawer Slides: ANSI/BHMA A156.9.
  - 1. Heavy Duty (Grade 1HD-100): Side mount.
    - a. Type: Full extension, 100 pound load rated.
    - b. Material: Zinc-plated steel ball bearing slides.
    - c. Motion Feature: Self-closing mechanism.

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- F. Label Holders: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches, attached with screws or rivets. Provide on drawers and cabinets.
- G. Locks: Cam type, brass with chrome-plated finish; complying with ANSI/BHMA A156.11, Type E07281 or Type E07261.
  - 1. Tumbler: Five pin.
  - 2. Lock Locations: Provide where indicated.
  - 3. Keying: Key locks alike within each room.
    - a. Master key for up to 225 key changes.
  - 4. Key Quantity: Minimum of two keys per lock.
  - 5. Master Key System: Key locks to be operable by master key.
    - a. Master Keys: Provide two.
- H. Adjustable Shelf Supports: ANSI/BHMA A156.9. Injection molded transparent polycarbonate friction fit into cabinet end panels and vertical dividers, adjustable on 32mm centers. Structural load to 1200 pounds (300 pounds per support) without failure. Mortise type and shelf rests.

## 2.6 COUNTERTOPS

- A. General: Provide laboratory countertops with integral sink as indicated on Drawings.
- B. Chemical Resistant Plastic Laminate Countertops:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Arboriate, Division of Wilsonart Canada ULC.
    - b. Formica Corporation.
    - c. Nevamar Company, LLC.
    - d. Wilsonart, LLC.
  - 2. Physical Properties: Minimum acceptable chemical-resistance performance to result in no more than four (4) Level 3 conditions when tested with indicated reagents in accordance with SEFA 3.
  - 3. All countertops: 1-1/8 inch thick ANSI A208.1-1993 MR10 moisture resistant (MR) particleboard.
  - 4. Surface: Chemical Resistant high-pressure decorative HGS/HGP laminate with balanced backer sheeting.
  - 5. Edges, including applied backsplash: 3mm PVC, exposed edges and corners machine profiled to 1/8 inch radius.
  - 6. All countertops joints must be dry fit at the factory to check for consistency in color from one panel to the other and overall finished panel thickness, resulting in a high quality product easy to install.
- C. Core Materials for Plastic Laminate:



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1. Certified Wood: Wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.
  2. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
- D. Adhesive for Bonding Plastic Laminate: Type II water-resistant type as selected by fabricator to comply with requirements.
1. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Epoxy: Factory-molded, modified epoxy-resin formulation with smooth, nonspecular finish.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. American Epoxy Scientific LLC.
    - b. Durcon; a Wilsonart Company.
    - c. Prime Industries, Inc.
  2. Physical Properties:
    - a. Flexural Strength: Not less than 10,000 psi.
    - b. Modulus of Elasticity: Not less than 2,000,000 psi.
    - c. Hardness (Rockwell M): Not less than 100.
    - d. Water Absorption (24 Hours): Not more than 0.02 percent.
    - e. Heat Distortion Point: Not less than 260 deg F.
    - f. Chemical Resistance: Minimum acceptable chemical-resistance performance to result in no more than four (4) Level 3 conditions when tested with indicated reagents in accordance with SEFA 3.
  3. Color: Gray.

## 2.7 CABINET FABRICATION

- A. Construction: Provide plastic-laminate laboratory casework of the following minimum construction:
1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch-thick particleboard.
  2. Tops, bottoms, and sides of sink base units are moisture resistant particle board core.
  3. Adjustable Shelves in Cabinets:
    - a. Core: Particleboard.
    - b. Core Thickness: 3/4-inch up to 30 inches wide, 1 inch over 30 inches wide.
    - c. Edge: 3mm PVC on front and back edges, 1mm PVC on side edges.

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4. Exposed Backs of Cabinets: 1/2-inch-thick particleboard or MDF.
  5. Backs of Cabinets: 1/4-inch-thick hardboard dadoed into sides, bottoms, and tops where not exposed unless otherwise indicated.
  6. Door/Drawer Fronts:
    - a. Core: 3/4 inch thick particleboard except at sink units which are 3/4 inch thick moisture resistant particleboard.
    - b. Chemical Resistant high-pressure decorative VGS laminate exterior, balanced with high-pressure cabinet liner CLS. Use of TFL on exterior or interior surfaces of door/drawer fronts will not be permitted.
    - c. Edges: 3mm PVC, machine applied, external edges and outside corners machine profiled to 1/8 inch radius.
  7. Drawer Sides and Backs: 1/2-inch-thick particleboard or MDF, with glued dovetail or multiple-dowel joints. Top edge banded with 1mm PVC.
  8. Drawer Bottoms: 1/2-inch-thick particleboard or MDF glued and dadoed into front, back, and sides of drawers.
  9. Fixed base and tall units have an individual factory-applied base, constructed of 3/4 inch thick plywood. Base is nominal 4 inch high unless otherwise indicated on the drawings.
  10. Exposed Ends:
    - a. Faced with Chemical Resistant high-pressure decorative VGS laminate. Use of TFL on exposed ends will not be permitted.
- B. Filler and Closure Panels: Provide where indicated and as needed to close spaces between casework and walls, ceilings, and equipment. Fabricate from same material and with same finish as adjacent exposed casework surfaces unless otherwise indicated.
1. Provide knee-space panels (modesty panels) at spaces between base cabinets, where cabinets are not installed against a wall or where space is not otherwise closed.

## 2.8 COUNTERTOP FABRICATION

- A. Countertops, General: Provide units with smooth surfaces in uniform plane, free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch.
- B. Sinks, General: Provide sizes indicated, as approved by Architect.
- C. Epoxy:
  1. Countertops: Fabricate with factory cutouts for sinks, holes for service fittings and accessories, and butt joints assembled with epoxy adhesive and concealed metal splines.
    - a. Flat Configuration: 3/4-inch thick with continuous drip groove on underside 1/2-inch from overhang edge.
      - 1) Edges and Corners: Rounded.
      - 2) Backsplash: Applied.
    - b. Construction: Uniform throughout full thickness.

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2. Sinks: As specified in Section 224200 "Commercial Plumbing Fixtures."
  - a. Provide sinks for underside installation with manufacturer's recommended adjustable support system for table- and cabinet-type installations.

2.9 LABORATORY ACCESSORIES

- A. Stainless Steel Pegboards: Stainless steel pegboards with removable polypropylene pegs and stainless steel drip troughs with drain outlet.
- B. Core Materials for Plastic Laminate:
  1. Certified Wood: Wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.
  2. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
- C. Adhesive for Bonding Plastic Laminate: Type II water-resistant type as selected by fabricator to comply with requirements.
  1. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CASEWORK

- A. Comply with installation requirements in SEFA 2. Install level, plumb, and true in line; shim as required using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
  1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
  2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
  3. Variation of Faces of Casework from a True Plane: 1/8 inch in 10 feet.
  4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
  5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

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- B. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
  - 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than two fasteners per side.
- C. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches o.c.
- D. Install hardware uniformly and precisely.
- E. Adjust operating hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

### 3.3 INSTALLATION OF COUNTERTOPS

- A. Comply with installation requirements in SEFA 2. Abut top and edge surfaces true in plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints where indicated on Shop Drawings.
- B. Field Jointing: Where possible, make in same manner as shop-made joints, using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Shop prepare edges for field-made joints.
- C. Fastening:
  - 1. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.
  - 2. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.
- D. Provide holes and cutouts required for service fittings.
- E. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
- F. Dress joints smooth, remove surface scratches, and clean entire surface.

### 3.4 INSTALLATION OF SINKS

- A. Comply with installation requirements in SEFA 2.
- B. Underside Installation of Stainless Steel Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table- and cabinet-type installations. Set top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing

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compound or adhesive, and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

3.5 INSTALLATION OF LABORATORY ACCESSORIES

- A. Install accessories in accordance with Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions.
- B. Securely fasten adjustable shelving supports, stainless steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.
- C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.
- D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.6 INSTALLATION OF SERVICE FITTINGS

- A. Comply with requirements in other Sections for installing water service fittings.
- B. Install fittings in accordance with Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

3.7 CLEANING AND PROTECTING

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

END OF SECTION

SECTION 123661 - SIMULATED STONE COUNTERTOPS AND WINDOW SILLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material window sills.
3. Accessories.

B. Related Requirements:

1. Section 224200 "Commercial Plumbing Fixtures" for non-integral sinks and plumbing fittings.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of countertop material.

C. Shop Drawings:

1. Plans, sections, details, edge and backsplash profiles, and attachment to other work.
2. Locations and details of joints.
3. Locations, quantity, and type of supports/brackets.
4. Direction of directional pattern, if any.
5. Locations and sizes of cutouts and holes for items installed in countertop.

D. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.

1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Coordination Drawings: Indicate locations and sizes of cutouts and holes for items installed in countertops or backsplashes.

C. Qualification Statements: For fabricator.

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1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include product data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.

1.6 MOCKUPS

- A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
  - 1. Build mockup of typical countertop as indicated on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.
- B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.8 FIELD CONDITIONS

- A. Field Measurements:
  - 1. Where countertops are indicated to fit to other construction, verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work..
  - 2. Verify window sill measurements before fabrication.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Quality Standard: Unless otherwise indicated, comply with ANSI/AWI 1236 for grades of simulated stone countertops indicated for construction, finishes, installation, and other requirements.
  - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grade specified.

2.2 SOLID SURFACE MATERIAL COUNTERTOPS

- A. Solid Surface Countertop Type :
  - 1. Grade: Custom.
- B. Solid Surface Material: Homogeneous fabrication of mineral fillers and pigments bound together with a matrix of polymers and resins, complying with ISFA 2-01.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Formica Everform or comparable product by one of the following:
    - a. DuPont; DuPont de Nemours, Inc.
    - b. LG Hausys, Ltd.
    - c. Wilsonart LLC
  - 2. Countertop:
    - a. Type: Standard.
    - b. Thickness:
      - 1) 3/4-inch-thick, solid surface material with front edge built up with same material.
    - c. Exposed Edge Treatment: Eased.
    - d. Backsplash: Detached straight.
      - 1) Height: 4 inches.
      - 2) Thickness: Matching countertop.
    - e. End Splash: None.
    - f. Color and Pattern: Bianco Material 758.
  - 3. Sink Bowls:
    - a. Separate unit for under-counter mounting.
    - b. Material: Stainless steel.
    - c. Shape: Rectangle.



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4. Window Sills:
  - a. Type: Standard.
  - b. Thickness: 1/2-inch with built up edge of same material.
  - c. Exposed Edge Treatment: Eased.
  - d. Colors and Pattern: To be selected from manufacturer's full range.

2.3 ACCESSORIES

A. Support Brackets:

1. Countertop:
  - a. Type: Hidden.
  - b. Basis-of-Design: Floating Countertop Wall Bracket by Iron Supports.
  - c. Material: Steel.
  - d. Color: White powder coat.

B. Grommets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Doug Mockett, BRV1 – 2-3/8-inch Brava Desk Grommet Set, or comparable product by one of the following:
  - a. Hafele America Co.
  - b. W.W. Grainger, Inc.
2. Wire-Management Grommets: Circular, grommets and matching caps with slot for wire passage.
  - a. Finish: Metal.
  - b. Outside Diameter: 2 inches.
  - c. Color: Satin chrome.

2.4 FABRICATION

- A. Fabricate countertops and window sills in sizes and shapes required to comply with requirements indicated.
- B. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
  1. Fabricate with loose backsplashes for field assembly.
- C. Joints:
  1. Fabricate countertops and window sills without joints.
  2. For "L" shaped countertops, fabricate in sections for joining in field.
    - a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a

countertop section less than 36 inches long would result, unless unavoidable.

D. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
  - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
2. Fittings: Drill countertops in shop for grommets, plumbing fittings, undercounter soap dispensers, and similar items.

2.5 INSTALLATION MATERIALS

- A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
  1. Laboratory Test Reports: For composite wood products, indicating compliance with the formaldehyde emissions evaluation.
  2. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in CARB 93120, "Airborne Toxic Control Measure (ATCM) for Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
- B. Adhesive: Product recommended by manufacturer.
  1. Verify adhesive complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive window sills and countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before installation, condition countertops and window sills to average prevailing humidity conditions in installation areas.

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- B. Examine shop-fabricated work for completion and complete work as required, including removal of packing.

### 3.3 INSTALLATION OF SIMULATED STONE COUNTERTOPS

- A. Grade: Install countertops and window sills to comply with specified grade.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
  - 1. Provide cutouts not finished in the shop. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- C. Countertop Installation:
  - 1. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
  - 2. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 3. Anchor wall cleating necessary for proper setting for countertops not supported by casework.
  - 4. Install countertops level to a tolerance of 1/8 inch in 8 ft., 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
  - 5. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
  - 6. Secure countertops to subtops with adhesive according to manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
  - 7. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
  - 8. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Pre-drill holes for screws as recommended by manufacturer.
  - 9. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls. Comply with Section 079200 "Joint Sealants."
- D. Window Sill Installation:
  - 1. Install window sills level to a tolerance of 1/8 inch in 8 feet, 1/4-inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
  - 2. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

### 3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

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- B. Clean countertops and window sills on exposed and semi-exposed surfaces.
- C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.
4. Solid surface material apron fronts.
5. Solid surface material sinks.
6. Solid surface material bench.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For countertop materials and sinks.
- C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
1. Show locations and details of joints.
  2. Show direction of directional pattern, if any.
- D. Shop Drawings: For benches and sills. Show material finishes details and methods of joining.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

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1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Wilsonart, LLC, or comparable product by one of the following:
    - a. Formica Corporation.
    - b. Livingstone Commercial.
  - 2. Type: Provide Standard type unless Special Purpose type is indicated.
  - 3. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.
  - 4. Colors and Patterns: As selected by Architect from manufacturer's full range-grade.
- B. Particleboard: ANSI A208.1, Grade M-2.

2.2 FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WT's "Architectural Woodwork Standards."
  - 1. Grade: Custom.
- B. Configuration:
  - 1. 1-1/2 inch laminated straight, slightly eased.
  - 2. Backsplash: Straight, slightly eased at corner.
  - 3. End Splash: Matching backsplash.

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C. Countertops:

1. 1/2-inch thick, solid surface material.

D. Backsplashes and End Panels: 1/2-inch thick, solid surface material.

E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Wilsonart Model AK 2716 ADA Compliant Under mount sink.
2. Install integral sink bowls in countertops in the shop.

F. Joints:

1. Fabricate countertops sills and benches without joints.

## 2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

C. Counter Bracket: RAKKS EH counter support bracket with rounded ends EHR-1818.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install countertops, sills and benches level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

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- C. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- D. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
  - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- F. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION



SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient-tile entrance mats and modular carpet tile mats.

1.2 COORDINATION

- A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

- B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

- C. Shop Drawings:

1. Items penetrating floor mats and frames, including door control devices.
2. Divisions between mat sections.
3. Perimeter floor moldings.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

- B. Maintenance Data: For floor mats and frames to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient-Tile Entrance Mats: Full-size tile units equal to 2 percent of amount installed, but no fewer than 10 units.

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PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS

- A. Structural Performance: Provide mats capable of withstanding the following loads and stresses within limits and under conditions indicated:
  - 1. Wheel load of 400 lb per wheel.
- B. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design."

2.2 RESILIENT-TILE ENTRANCE MATS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide Milliken Obex Grid: CutX (WM-1) and Milliken Obex Tile: CutX (WM-2), or comparable product by one of the following:
  - 1. Mats Inc.
  - 2. The R.C. Musson Rubber Co.
- B. Vinyl With Textile Insert Tiles (WM-1): 7/16-inch-thick, solid, vinyl compound molded tiles with concealed interlocking joint tabs.
  - 1. Colors, Textures, and Patterns: As selected by Architect from full range of industry colors.
  - 2. Grid Size: 7.87 by 7.87 inches.
  - 3. Textile Insert: Tufted, cut pile nylon and monofilament.
  - 4. Tufted Face Weight: 24 oz/yd<sup>2</sup>.
- C. Carpet-Type Tiles (WM-2): Nylon and Monofilament carpet bonded to PVC-Free WellBAC® Comfort Plus Cushion to form mats 7/16 inch thick with nonraveling edges.
  - 1. Colors, Textures, and Patterns: As selected by Architect from full range of industry colors.
  - 2. Tile Size: 19.7 by 19.7 inches.
  - 3. Tufted Face Weight: 24 oz/yd<sup>2</sup>.
  - 4. Gauge: 5/32.

2.3 ACCESSORIES

- A. Brushed Stainless Steel Floor Transition Molding with leg that returns under tile by Wisdom Tile Accessories for transition from WM-1 to PT-1.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install surface-type units to comply with manufacturer's written instructions; coordinate with entrance locations and traffic patterns.
  - 1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.
  - 2. Bond mats to the subfloor with a full spread permanent adhesive recommended by flooring manufacturer.
  - 3. Install edge kit at flooring transition as required.

3.3 PROTECTION

- A. Protect flooring and maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION

SECTION 210517 – SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves without waterstop.
2. Sleeves with waterstop.
3. Sleeve-seal systems.
4. Grout.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATERSTOP

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
- C. Steel Sheet Sleeves: ASTM A653/A653M, 0.0239-inch minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

## 2.2 SLEEVES WITH WATERSTOP

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Advance Products & Systems, LLC.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex Company (The).
- B. Description: Manufactured galvanized steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

## 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Advance Products & Systems, LLC.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex Company (The).
  5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Designed to form a hydrostatic seal of 20 psig minimum.
  2. Sealing Elements: EPDM-rubber or Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
  3. Pressure Plates: Carbon steel or Stainless steel.
  4. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating or Stainless steel of length required to secure pressure plates to sealing elements.

## 2.4 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using grout, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

#### 3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal space around outside of sleeves.

### 3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
  - 2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

### 3.5 SLEEVE SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above and below Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 2. Concrete Slabs-on-Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs above Grade:
    - a. Sleeves with waterstops.
  - 4. Interior Walls and Partitions:
    - a. Sleeves without waterstops.

END OF SECTION

SECTION 210518 – ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Escutcheons.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is to be described, clearly annotate which product(s) is to be supplied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. BrassCraft Manufacturing Co.; a Masco company.
  - 2. Dearborn Brass.
  - 3. Jones Stephens Corp.
  - 4. Keeney Manufacturing Company (The).
  - 5. Mid-America Fittings, LLC; A Midland Industries Company.
  - 6. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.



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- C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons.

END OF SECTION

SECTION 210523 – GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. Trim and drain valves.

1.2 DEFINITIONS

- A. NRS: Nonrising stem.
- B. OS&Y: Outside screw and yoke.
- C. SBR: Styrene-butadiene rubber.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of valve. On data submittal sheets where more than one product is to be described, clearly annotate which product(s) is to be supplied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

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- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" and shall bear UL mark:
- B. FM Global Approved: Valves shall be listed in its "Approval Guide."
- C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- D. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded-end valves.
  - 2. ASME B16.1 for flanges on iron valves.
  - 3. ASME B31.9 for building services piping valves.
- E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- F. NFPA Compliance for valves:
  - 1. Comply with NFPA 13 and NFPA 24.
- G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Actuator Types:
  - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
  - 2. Handwheel: For other than quarter-turn trim and drain valves.
  - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

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2.3 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ames Fire & Waterworks; A Watts Water Technologies Company.
2. NIBCO INC.
3. Victaulic Company.

- B. Description:

1. UL 1091, except with ball instead of disc and FM Global approved for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.4 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ALEUM USA.
2. Globe Fire Sprinkler Corporation.
3. Milwaukee Valve Company.

- B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 175 psig.
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Bronze or stainless steel.
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

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2.5 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ALEUM USA.
2. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
3. Globe Fire Sprinkler Corporation.
4. Kennedy Valve Company; a division of McWane, Inc.
5. NIBCO INC.
6. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
7. Victaulic Company.
8. Zurn Industries, LLC.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved-end connections.

2.6 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Ames Fire & Waterworks; A Watts Water Technologies Company.
2. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
3. FEBCO; A WATTS Brand.
4. Globe Fire Sprinkler Corporation.
5. Kennedy Valve Company; a division of McWane Inc.
6. Mueller Co. LLC; Mueller Water Products, Inc.
7. NIBCO INC.
8. Reliable Automatic Sprinkler Co., Inc. (The).
9. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
10. United Brass Works, Inc.
11. Victaulic Company.
12. Viking Group Inc.
13. WATTS; A Watts Water Technologies Company.
14. Zurn Industries, LLC.

B. Description:

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1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.7 BRONZE OS&Y GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Milwaukee Valve Company.
2. NIBCO INC.
3. United Brass Works, Inc.
4. Zurn Industries, LLC.

- B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

2.8 IRON OS&Y GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. American Cast Iron Pipe Company.
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Hammond Valve.
4. Mueller Co. LLC; Mueller Water Products, Inc.
5. NIBCO INC.
6. Victaulic Company.
7. WATTS; A Watts Water Technologies Company.
8. Zurn Industries, LLC.

- B. Description:

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1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged or grooved.

## 2.9 TRIM AND DRAIN VALVES

### A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
  - c. Jomar Valve.
  - d. Legend Valve & Fitting, Inc.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Potter Roemer LLC; a Division of Morris Group International.
  - h. Red-White Valve Corp.
  - i. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  - j. Victaulic Company.
  - k. WATTS; A Watts Water Technologies Company.
  - l. Zurn Industries, LLC.
2. Description:
  - a. Pressure Rating: 175 psig.
  - b. Body Design: Two piece.
  - c. Body Material: Forged brass or bronze.
  - d. Port size: Full or standard.
  - e. Seats: PTFE.
  - f. Stem: Bronze or stainless steel.
  - g. Ball: Chrome-plated brass.
  - h. Actuator: Handlever.
  - i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
  - j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

### B. Globe Valves:

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. NIBCO INC.
  - b. United Brass Works, Inc.
2. Description:
  - a. Pressure Rating: 175 psig.
  - b. Body Material: Bronze with integral seat and screw-in bonnet.
  - c. Ends: Threaded.
  - d. Stem: Bronze.
  - e. Disc Holder and Nut: Bronze.
  - f. Disc Seat: Nitrile.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron, bronze, or aluminum.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 INSTALLATION, GENERAL

- A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:
  1. Section 21 13 13 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
  2. Section 33 14 15 "Site Water Distribution Piping" for application of valves in fire-suppression water-service piping.



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- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.
- C. Install double-check valve assembly in each fire-protection water-supply connection.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 21 05 53 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION

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SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Metal framing systems.
  - 3. Thermal hanger-shield inserts.
  - 4. Fastener systems.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
- B. NFPA Compliance: Comply with NFPA 13.
- C. UL Compliance: Comply with UL 203.

### 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

### 2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
  - 1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
  - 2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 3. Channels: Continuous slotted carbon-steel channel with inturned lips.
  - 4. Channel Width: Selected for applicable load criteria.
  - 5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  - 7. Metallic Coating: Electroplated zinc or hot-dip galvanized.

### 2.4 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Carpenter & Paterson, Inc.
  - 2. National Pipe Hanger Corporation.
  - 3. Pipe Shields Inc.
  - 4. Piping Technology & Products, Inc.
  - 5. Rilco Manufacturing Co., Inc.
  - 6. Value Engineered Products, Inc.

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- B. Insulation-Insert Material: ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.
- C. For Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Indoor Applications: Zinc-coated or Stainless steel.

## 2.6 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits.

Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

### 3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut systems.
- C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
  - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- I. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
  - 1. Attach clamps and spacers to piping.

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- a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
  - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
  - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. MSS SP-58, Type 39 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. MSS SP-58, Type 40 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### 3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.4 PAINTING

- A. Touchup:
  1. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- F. Use thermal hanger-shield inserts for insulated piping and tubing.
- G. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
  - 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Comply with NFPA requirements.

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- J. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. C-Clamps (MSS Type 23): For structural shapes.
  - 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- K. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  - 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION



## SECTION 210553 – IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.

#### 1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Brady Corporation.
  - b. Carlton Industries, LP.
  - c. Champion America.
  - d. Craftmark Pipe Markers.
  - e. Kolbi Pipe Marker Co.
  - f. LEM Products Inc.

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- g. [Marking Services Inc.](#)
  - h. [Pipemarker.com; Brimar Industries, Inc.](#)
  - i. [Seton Identification Products; a Brady Corporation company.](#)
  - j. [emedco.](#)
- 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
  - 3. Letter and Background Color: As indicated for specific application under Part 3.
  - 4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 7. Fasteners: Stainless steel rivets or self-tapping screws.
  - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

## 2.2 WARNING SIGNS AND LABELS

- A. [Manufacturers](#): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. [Brady Corporation.](#)
  - 2. [Carlton Industries, LP.](#)
  - 3. [Champion America.](#)
  - 4. [Craftmark Pipe Markers.](#)
  - 5. [LEM Products Inc.](#)
  - 6. [Marking Services Inc.](#)
  - 7. [National Marker Company.](#)
  - 8. [Pipemarker.com; Brimar Industries, Inc.](#)
  - 9. [Seton Identification Products; a Brady Corporation company.](#)
  - 10. [Stranco, Inc.](#)
  - 11. [emedco.](#)
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

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- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
  - 2. Brady Corporation.
  - 3. Carlton Industries, LP.
  - 4. Champion America.
  - 5. Craftmark Pipe Markers.
  - 6. Kolbi Pipe Marker Co.
  - 7. LEM Products Inc.
  - 8. Marking Services Inc.
  - 9. Pipemarker.com; Brimar Industries, Inc.
  - 10. Seton Identification Products; a Brady Corporation company.
  - 11. emedco.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:
  - 1. Pipe size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
  - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

## 2.4 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.

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2. [Brady Corporation.](#)
  3. [Carlton Industries, LP.](#)
  4. [Champion America.](#)
  5. [Craftmark Pipe Markers.](#)
  6. [Kolbi Pipe Marker Co.](#)
  7. [LEM Products Inc.](#)
  8. [Marking Services Inc.](#)
  9. [Pipemarker.com; Brimar Industries, Inc.](#)
  10. [Seton Identification Products; a Brady Corporation company.](#)
  11. [emedco.](#)
- B. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.04 inch thick, with predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire, link chain, beaded chain or S-hook.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Include valve-tag schedule in operation and maintenance data.
- E. Valve Tag Contents: Include identification of valve function and normally open or closed position.
1. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

#### 3.2 INSTALLATION GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.

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- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

### 3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of fire-suppression equipment.
- B. Sign and Label Colors:
  - 1. White letters on an ANSI Z535.1 safety-red background.
- C. Locate equipment labels where accessible and visible.

### 3.4 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Section 09 91 23 "Interior Painting."
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within 3 ft. of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit a view of concealed piping.
  - 3. Within 3 ft. of equipment items and other points of origination and termination.
  - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- D. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Fire-Suppression Pipe Label Color Schedule:
  - 1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

### 3.5 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule in the operating and maintenance manual. Include the identification "FSV" on all fire-suppression system valve tags.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
  - 1. Valve-Tag Size and Shape:

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- a. Wet-Pipe Sprinkler System: 1-1/2 inches, round (minimum, or as required to fix text).
2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red background.

END OF SECTION

## SECTION 210800 – COMMISSIONING OF FIRE SUPPRESSION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes Cx process requirements for the following fire-suppression systems, assemblies, and equipment:
  - 1. Water-based fire-suppression systems.
  - 2. Fire-extinguishing systems.
- B. Related Requirements:
  - 1. Section 01 91 13 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
  - 2. For construction checklists, comply with requirements in various Division 21 Sections specifying fire-suppression systems, system components, equipment, and products.

#### 1.2 DEFINITIONS

- A. Cx: Commissioning, as defined in Section 01 91 13 "General Commissioning Requirements."
- B. CxA: Commissioning Authority, as defined in Section 01 91 13 "General Commissioning Requirements."
- C. IgCC: International Green Construction Code.
- D. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For fire-suppression testing technician.
- C. Construction Checklists:
  - 1. Draft Cx plan, including draft construction checklists to be prepared by CxA under Section 01 91 13 "General Commissioning Requirements." Contractor is to review Construction Checklist in accordance with requirements in Section 01 91 13 "General Commissioning Requirements" and NFPA 3 and to resolve any issues with the CxA.

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2. Cx plan, including material, installation, and performance construction checklists for systems, assemblies, subsystems, equipment, and components relating to fire-suppression system to be part of the Cx process and in accordance with requirements in Section 01 91 13 "General Commissioning Requirements" and NFPA 3.
- D. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Contractor, provide the following:
1. Equipment/instrument identification number.
  2. Planned Cx application or use.
  3. Manufacturer, make, model, and serial number.
  4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
  5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:
    - a. Instrument or tool identification number.
    - b. Equipment schedule designation of equipment for which the instrument or tool is required.
    - c. Manufacturer, make, model, and serial number.
    - d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

#### 1.4 QUALITY ASSURANCE

- A. Fire-Suppression Testing Technician Qualifications: Technicians to perform fire-suppression Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
1. Journey level or equivalent skill level with knowledge of fire-suppression system, electrical concepts, and building operations.
  2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Clean-Agent Fire-Suppression Systems Testing Technician Qualifications: Technicians to perform clean-agent fire-suppression system Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate's degree in mechanical systems, fire-suppression systems, or similar field. Degree requirement may be offset by three years' experience in servicing fire-suppression systems in the clean-agent fire-suppression systems industry. Generally, required knowledge includes clean-agent fire-suppression systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of fire-suppression system equipment, assemblies, and systems.
  2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.



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C. Testing Equipment and Instrumentation Quality and Calibration:

1. Capable of testing and measuring performance within the specified acceptance criteria.
2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
3. Be maintained in good repair and operating condition throughout duration of use on Project.
4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.

D. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
  - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
  - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
  - c. Fire-suppression system proprietary test instrumentation and tools become property of University at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Cx PROCESS

A. Perform Cx process for fire-suppression system in accordance with the following:

1. Section 01 91 13 "General Commissioning Requirements."
2. NFPA 3.
3. IgCC, which requires compliance with ASHRAE 202.

3.2 CONSTRUCTION CHECKLISTS

A. Preliminary detailed construction checklists are to be prepared under Section 01 91 13 "General Commissioning Requirements" for each fire-suppression system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in NFPA 3 and IgCC. Contractor performs the following:

1. Review fire-suppression system preliminary construction checklists and provide written comments on Construction Checklist items where appropriate.
2. Return preliminary Construction Checklist with review comments within 10 days of receipt.

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3. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
4. Use only construction checklists marked "Approved for Use, (date)" when performing tests. Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.

B. Additional Systems Required to Be Commissioned:

1. Facility fire-suppression water-distribution piping outside the building, including the following:
  - a. Fire-suppression water piping, fittings, and specialties outside the building.
  - b. Hydrants and fire-department connections.
  - c. Fire-alarm devices.
  - d. Meters and meter pits.
  - e. Sleeves and sleeve seals.
  - f. Meters and gauges.
  - g. General-duty and specialty valves.
  - h. Hangers and supports.
  - i. Vibration isolation and seismic restraints.
  - j. Identification.
  - k. Insulation.
2. Fire-suppression sprinkler systems, including the following:
  - a. Wet-pipe sprinkler piping, fittings, sprinklers, and specialties.
  - b. Sleeves and sleeve seals.
  - c. Meters and gauges.
  - d. General-duty and specialty valves.
  - e. Hangers and supports.
  - f. Vibration isolation and seismic restraints.
  - g. Identification.
  - h. Insulation.
3. Clean-agent fire-extinguishing systems, including the following:
  - a. Piping, fittings, outlets, and specialties.
  - b. Storage tanks, manifolds, mounting devices, controls, and accessories.
  - c. Sleeves and sleeve seals.
  - d. Meters and gauges.
  - e. General-duty and specialty valves.
  - f. Hangers and supports.
  - g. Vibration isolation.
  - h. Identification.
  - i. Insulation.
4. Documentation:
  - a. Fire-suppression system operating manuals.
  - b. Documentation of required Cx.
  - c. Documentation of required operator training.

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3.3 Cx TESTING PREPARATION

- A. Certify that fire-suppression systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that fire-suppression system instrumentation and control systems have been completed and calibrated, that they are operating in accordance with the Contract Documents and approved submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.4 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
  - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
  - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
  - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the fire-suppression system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.
- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation, and schedule seasonal tests.

3.5 Cx TESTS COMMON TO FIRE-SUPPRESSION SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response compared to acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.

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- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 21 Sections specifying fire-suppression systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
  - 1. Cx Construction Checklist verification tests.
  - 2. Cx Construction Checklist verification test demonstrations.

### 3.6 CONSTRUCTION CHECKLIST EXAMPLES

- A. Supervision of Fire-Protection Valves in Water-Based Fire-Suppression Systems:
  - 1. Prerequisites: Acceptance of results of construction checklists for valves specified in the following Sections:
    - a. Section 21 05 23 "General-Duty Valves for Water-Based Fire Protection Piping."
    - b. Section 21 13 13 "Wet-Pipe Sprinkler Systems."
    - c. Section 28 46 21.11 "Addressable Fire-Alarm Systems."
    - d. Section 28 46 21.13 "Conventional Fire-Alarm Systems."
    - e. Section 33 14 15 "Site Water Distribution Piping."
  - 2. Equipment and Systems to Be Tested:
    - a. Supervised valves in water-based fire-suppression systems.
    - b. Division 28 fire-detection and -alarm systems.
  - 3. Test Purpose: Verify generation of supervisory alarm at the fire-alarm control panel in response to activation of valve supervision device or tamper switch.
  - 4. Test Conditions:
    - a. Fire-alarm system operating in normal, automatic mode.
    - b. Activate valve supervision devices and tamper switches, one at a time.
  - 5. Acceptance Criteria: Activation of valve supervision device or tamper switch generates supervisory alarm at fire-alarm control panel.

### 3.7 Cx TESTS FOR CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS

- A. Clean-Agent Concentration in Clean-Agent Fire-Extinguishing System:
  - 1. Prerequisites:
    - a. Acceptance of results of construction checklists for Section 212200 "Clean-Agent Fire-Extinguishing Systems."
    - b. Acceptance of construction checklists specified in Division 23 for systems and equipment serving the protected space.

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- c. Partitions, ceilings, doors, and other openings complete in the vicinity of the protected space.
- 2. Systems and Equipment to Be Tested:
  - a. Clean-agent fire-extinguishing systems.
  - b. HVAC system protected space isolation equipment.
  - c. Protected space enclosure.
- 3. Test Purpose: Evaluate initial and final clean-agent concentration in the protected space following carbon-dioxide release.
- 4. Test Conditions:
  - a. HVAC systems operating in normal, occupied, automatic control.
  - b. Fire-detection and -alarm systems operating in normal, occupied, automatic control.
  - c. Clean-agent fire-extinguishing system charged and operating in normal, occupied, automatic control.
  - d. Protected space air temperature is 70 deg F.
  - e. Create a fire-alarm event in the clean-agent protected space, resulting in discharge of clean-agent fire-extinguishing system.
  - f. Measure and record clean-agent concentration at four locations selected by the CxA when the clean agent is completely dispersed and at the end of holding time.
- 5. Acceptance Criteria: Clean-agent concentration is no less than 34 percent concentration by volume at 70 deg F.

END OF SECTION

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SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-suppression piping, fittings, and appurtenances.
2. System control valves.
3. Dry-sprinkler system nitrogen generator with purge/vent.
4. Fire-suppression piping specialties.
5. Sprinklers.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gauges.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for site fire-suppression water-service and backflow prevention devices.

1.2 DEFINITIONS

- A. Standard-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure of 175 psig maximum.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. For each type of product.
  - a. Include construction details, material descriptions, dimensions of individual components and profiles.
  - b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings:

1. Prepare in accordance with NFPA 13 section "Working Plans."
  - a. Include plans, elevations, and sections of the system piping and details.

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- b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.
  - c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 2. Prepare computer-generated hydraulic calculations in accordance with the following:
  - a. Minimum operating pressure at hydraulically most remote fire hose valve is to be 100 psig.
  - b. Name of hydraulic program used.
  - c. Water supply information, including fire hydrant flow test data report.
- 3. Submit documents and calculations signed and sealed by qualified professional engineer responsible for their preparation
- 4. Include diagrams for power, signal, and control wiring.
- D. Delegated Design Submittals: For fire-suppression systems indicated to comply with performance requirements and design criteria, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Fire-suppression system plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.
- C. Seismic Qualification Certificates: For fire-suppression equipment, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For qualified Installer, professional engineer, and NICET-certified technician.
- E. Design Data: Approved fire-suppression piping working plans, prepared in accordance with NFPA 13, including documented approval by AHJs, and including hydraulic calculations if applicable.
- F. Welding certificates.
- G. Field Test Reports:

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1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
2. Fire-hydrant flow test report.

H. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
  2. System control valves.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

1.8 FIELD CONDITIONS

- A. Interruption of Existing Fire-Suppression Service: Do not interrupt fire-suppression service to facilities occupied by Owner or others unless permitted under the following conditions and then



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only after arranging to provide temporary fire-suppression service in accordance with requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of fire-suppression service.
2. Do not proceed with interruption of fire-suppression service without Owner's written permission.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Automatic wet-pipe sprinkler system.
- B. Automatic dry-pipe sprinkler.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-suppression system piping to withstand the effects of earthquake motions determined in accordance with NFPA 13.
- B. Fire-Suppression System Components, Devices, and Accessories: Listed in UL's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Fire-suppression system equipment, specialties, accessories, installation, and testing to comply with NFPA 13.
- E. Standard-Pressure Piping System Component: Listed for 175 psig minimum working pressure.
- F. Delegated Design: Engage a qualified professional engineer to design fire-suppression systems.
  1. Fire-Hydrant Flow Test:
    - a. Perform fire-hydrant flow test and record the following conditions:
      - 1) Date:
      - 2) Time:
      - 3) Performed by:
      - 4) Location of Residual Fire Hydrant R:
      - 5) Location of Flow Fire Hydrant F:
      - 6) Static Pressure at Residual Fire Hydrant R:
      - 7) Measured Flow at Flow Fire Hydrant F:
      - 8) Residual Pressure at Residual Fire Hydrant R:
    - b. Fire-hydrant flow test must be performed within previous 12 months prior to completion of design documents and hydraulic calculations.

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2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
3. Maximum protection area per sprinkler in accordance with UL listing.

G. Obtain documented approval of fire-suppression system design from AHJs.

## 2.3 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

### A. Steel Pipe, Fittings, and Appurtenances:

1. Schedule 40 Steel Pipe: Black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
  - a. Standards:
    - 1) UL 852.
    - 2) FM 1630.
  - b. Factory-applied exterior coating.
  - c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
  - d. Pipe ends may be factory or field formed to match joining method.
2. Schedule 10 Steel Pipe: Black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
  - a. Standards:
    - 1) UL 852.
    - 2) FM 1630.
  - b. Factory-applied exterior coating.
  - c. Factory-applied bacterial resistant internal coating to reduce microbiologically influenced corrosion.
  - d. Pipe ends may be factory or field formed to match joining method.
3. Engineered Light-Wall Steel Pipe: Black-steel pipe, ASTM A135/A135M or ASTM A795/A795M with wall thickness less than Schedule 40. Outside dimension is to be equivalent to Schedule 40.
  - a. Standards:
    - 1) UL 852.
    - 2) FM 1630.
  - b. Factory-applied exterior coating.
  - c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
  - d. Pipe ends may be factory or field formed to match joining method.

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4. Steel Pipe Nipples: Black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
5. Steel Couplings: Uncoated steel, ASTM A865/A865M, threaded.
6. Gray-Iron Threaded Fittings: Uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
7. Malleable- or Ductile-Iron Unions: ASME B16.3.
8. Cast-Iron Flanges: ASME B16.1, Class 125.
9. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
  - a. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
    - 1) Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
    - 2) Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
  - b. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.
10. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
  - a. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
11. Plain-End-Pipe Fittings:
  - a. Pressure Rating: 175 psig minimum.
  - b. Plain-End Fittings for Steel Piping: Uncoated plain-end fittings, ASTM A53/A53M, carbon steel or ASTM A106/A106M, forged steel with dimensions matching steel pipe.
  - c. Plain-End-Pipe Couplings for Steel Piping: Rigid pattern for steel-pipe dimensions, ductile-iron or malleable-iron housing. Include EPDM-rubber gasket, and bolts and nuts.
12. Grooved-Joint, Steel-Pipe Appurtenances:
  - a. Pressure Rating: 175 psig minimum.
  - b. Grooved-End Fittings for Steel Piping: Uncoated grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
  - c. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
13. Carbon Steel Pressure-Seal Fittings: UL 213, FM Approvals-approved, 175 psig pressure rating with carbon steel-, zinc-nickel-coated housing, EPDM O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

B. Copper Tube, Fittings, and Appurtenances:

1. Copper Tube, Drawn Temper: ASTM B88, Type L.
2. Solder-Joint Fittings, Cast Copper: ASME B16.18 pressure fittings.

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3. Solder-Joint Fittings, Wrought Copper: ASME B16.22 pressure fittings.
4. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
5. Unions, Cast Copper: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
6. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

## 2.4 SYSTEM CONTROL VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
- B. Pressure Rating:
  1. Standard-Pressure Piping Valves: 175 psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. System Control Valve, Alarm Valve:
  1. Standard: UL 193.
  2. Design: For horizontal or vertical installation.
  3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
  4. Drip cup assembly pipe drain with check valve to main drain piping.
- G. System Control Valve, Dry-Pipe Valve:
  1. Standards:
    - a. UL 260.
    - b. UL 1486.
  2. Design: Differential-pressure type.
  3. Include quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
  4. Air-Pressure Maintenance Device for Dry-Pipe Valve:
    - a. Standard: UL 260.
    - b. Description: Automatic device to maintain minimum air pressure in piping.
    - c. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14 to 60 psig adjustable range, and 175 psig outlet pressure.
  5. Air Compressor for Dry-Pipe Valve:

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- a. Motor Horsepower: Fractional.
- b. Power: 120 V ac, 60 Hz, single phase.
- c. Sized for application and capable of achieving system supervisory pressure within 30 minutes in accordance with requirements of NFPA standards. Provide ASME air receiver tank as required to meet requirements on larger systems.
- d. Include filters, relief valves, coolers, automatic drains, and gauges.

2.5 DRY-SPRINKLER SYSTEM NITROGEN GENERATOR WITH PURGE/VENT

- A. Description: Nitrogen generator system to serve dry sprinkler zones for piping corrosion mitigation, including system venting. System is to provide required supervisory pressure within sprinkler zone. System is to include either an integrated, oil-less air compressor, located within the nitrogen generator system package, or a separate vibration-isolation mounted air compressor, also provided by nitrogen generator manufacturer.
- B. Standards:
  1. FM 1035.
  2. UL 508A.
- C. Nitrogen Generator:
  1. Wall-mounted nitrogen generator to provide minimum nitrogen purity of 98 percent to the designated sprinkler systems.
  2. Power: 120 V ac.
  3. Bypass mode and nitrogen-generating mode.
  4. Minimum Capacity: As recommended by manufacturer.
- D. Air Compressor:
  1. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
  2. Motor Horsepower: Fractional.
    - a. Power: 120 V ac, 60 Hz, single phase.
  3. Sized for application and capable of achieving system supervisory pressure within 30 minutes in accordance with requirements of NFPA 13. Provide ASME air receiver tank as required to meet requirements on larger systems.
  4. Include filters, relief valves, coolers, automatic drains, and gauges.
  5. Minimum Capacity: Match capacity of nitrogen generator.
- E. Automatic Purge Vent/Valve:
  1. Vents oxygen during system nitrogen fill.
  2. Automatically closes when 98 percent minimum nitrogen has been reached.
  3. Sized to allow correct purge rate per manufacturer's written instructions.
  4. Provide one venting device for each dry/preaction sprinkler system zone.
  5. Include a connection port for a portable nitrogen purity sensor or a nitrogen purity manifold.

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F. Supervisory Gas Monitoring - Nitrogen Purity Sensing Device:

1. Portable Handheld Nitrogen Purity Sensing Device: Portable sensing device to connect to the outlet of the automatic purge/vent valve during periodic inspections to obtain a nitrogen purity reading within each zone.
2. Permanently Mounted Nitrogen Purity Monitoring Device or Manifold: Permanent monitoring device to continuously monitor system's nitrogen purity.

G. BAS Alarm Integration:

1. Provide nitrogen-generation system with integrated leak-detection and bypass alarms. Program alarms into controller and connect to BAS.
  - a. Leak-detection system is to alarm if leaks develop within fire-suppression system piping.
  - b. Air bypass alarm is to activate if nitrogen-generation system is bypassed by air compressor.

2.6 FIRE-SUPPRESSION PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Standard: UL 213.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-tee and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:

1. Standard: UL 199.
2. Pressure Rating: 175 psig.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

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D. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Standard: UL 1474.
2. Pressure Rating: 250 psig minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

1. Standards:
  - a. UL 2443.
  - b. FM 1637.
2. Description: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175 psig minimum.
4. Size: Same as connected piping, for sprinkler.

G. Automatic (Ball-Drip) Drain Valves:

1. Pressure Rating: 175 psig minimum.
2. Type: Automatic draining, ball check.
3. Size: NPS 3/4.
4. End Connections: Threaded.

H. Manual Air Vent/Valve:

1. Description: Ball valve that requires human intervention to vent air.
2. Body: Forged brass.
3. Ends: Threaded.
4. Minimize Size: 1/2 inch.
5. Minimum Water Working Pressure Rating: 300 psig.

I. Automatic Air Vent Assembly:

1. Description: Automatic air vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly. Approved for use in wet-pipe fire-suppression system.
2. Vents oxygen continuously from system.
3. Float valve to prevent water discharge.

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4. Minimum Water Working Pressure Rating: 175 psig.

## 2.7 SPRINKLERS

### A. Standards:

1. UL 199.
2. UL 1767.
3. UL 1626.
4. FM 2000.
5. FM 2008.
6. FM 2030.

### B. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

### C. Pressure Rating for Sprinklers:

1. Standard Automatic Sprinklers: 175 psig minimum.

### D. Sprinklers, Automatic Wet with Heat-Responsive Element:

1. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
2. Standard Spray, Standard Response:
  - a. Upright.
  - b. Pendent.
  - c. Recessed pendent.
  - d. Flat, concealed pendent.
  - e. Vertical sidewall.
  - f. Horizontal sidewall.
3. Standard Spray, Quick Response:
  - a. Upright.
  - b. Pendent.
  - c. Recessed pendent.
  - d. Flat, concealed pendent.
  - e. Vertical sidewall.
  - f. Horizontal sidewall.
  - g. Flat, concealed horizontal sidewall.
4. Extended Coverage:
  - a. Upright.
  - b. Pendent.
  - c. Flat, concealed pendent.
  - d. Horizontal sidewall.
  - e. Flat, concealed horizontal sidewall.



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5. Residential:

- a. Recessed pendent.
- b. Flat, concealed pendent.
- c. Flat, concealed horizontal sidewall.

E. Sprinklers, Automatic Dry with Heat-Responsive Element:

1. Standard Spray, Standard Response:

- a. Upright.
- b. Pendent.
- c. Recessed pendent.
- d. Flat, concealed pendent.
- e. Horizontal sidewall.

2. Standard Spray, Quick Response:

- a. Upright.
- b. Pendent.
- c. Recessed pendent.
- d. Flat, Concealed pendent.
- e. Horizontal sidewall.
- f. Flat, concealed horizontal sidewall.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

- 1. Ceiling Mounting: Chrome-plate steel, one piece, flat.
- 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards and Water Shields:

- 1. Standard: UL 199.
- 2. Description: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

A. Match alarm-device material and connection types to piping and equipment materials and connection types.

B. Water-Motor-Operated Alarm:

- 1. Standard: UL 753.
- 2. Type: Mechanically operated, with Pelton wheel.
- 3. Alarm Gong: Cast aluminum with red-enamel factory finish.
- 4. Size: 8-1/2-inch diameter.
- 5. Components: Shaft length, bearings, and sleeve to suit wall construction.
- 6. Inlet: NPS 3/4.
- 7. Outlet: NPS 1 drain connection.

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C. Electrically Operated Notification Appliances:

1. Electric Bell:

- a. Standard: UL 464.
- b. Type: Vibrating, metal alarm bell.
- c. Size: 8-inch minimum- diameter.
- d. Voltage: 120 V ac, 60 Hz, single phase or 24 V dc.
- e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.

2. Strobe/Horn:

- a. Standard: UL 464.
- b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
- c. Voltage: 120 V ac, 60 Hz.
- d. Effective Intensity: 110 cd.
- e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
- f. Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing viewers to call 911, police or fire department.

D. Water-Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125 V ac and 0.25 A, 24 V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig.
6. Design Installation: Horizontal or vertical.

E. Pressure Switches - Water-Flow Alarm Detection:

1. Description: Electrically supervised, pressure-activated water-flow switch with retard feature.
2. Components: Two single-pole, double-throw switches with normally closed contacts.
3. Design Operation: Rising pressure to 6 psi, plus or minus 2 psi signals water flow.
4. Adjustability: Each switch is to be independently adjustable.
5. Wire Separation: Pressure switch to provide for separation of wiring to each switch connection to allow for low- and high-voltage connections to comply with NFPA 70, Article 760 requirements.

F. Pressure Switches - Low/High Air Pressure Supervisory:

1. Description: Electrically supervised pressure supervisory switch.

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2. Components: Two single-pole, double-throw switches.
3. Design Operation: Detects increase and/or decrease from normal supervisory air pressure.
4. Adjustability: Each switch is to be independently adjustable.
5. Wire Separation: Pressure switch to provide for separation of wiring to each switch connection to allow for low- and high-voltage connections to comply with NFPA 70, Article 760 requirements.

G. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Design: Signals that controlled valve is in other than fully open position.
4. Wire Terminal Designations: Indicates normal switch position when switch is properly installed on valve and valve is fully open.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. OS&Y Valve Supervisory Switches:
  - a. One or two single-pole, double-throw switches.
  - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
  - c. Visual Switch Indication: Indicates device is properly installed and OS&Y valve is fully open.
  - d. Mounting Hardware: Mounting bracket to grip valve yoke and prevent movement of switch assembly on OS&Y valve.
  - e. Trip Rod Length: Adjustable
7. Butterfly Valve Supervisory Switches:
  - a. Two single-pole, double-throw switches.
  - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
  - c. Mounting Hardware: Removable nipple.
  - d. Trip Rod Length: Adjustable
8. Ball Valve Supervisory Switches:
  - a. One single-pole, double-throw switch.
  - b. NEMA Rating: NEMA 4 enclosure suitable for mounting in any position indoors or outdoors.
  - c. Mounting Hardware: Suitable for mounting directly to pipe, ball valves, or backflow preventers sized from up to NPS 2.

2.9 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gauge Range: 0 to 250 psig minimum.

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- D. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.
- E. Air System Piping Gauge: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.
  - 1. Flow test is to be performed to meet the criteria established by NFPA 13.
  - 2. Flow test is to be conducted in accordance with NFPA 291.
  - 3. Test is to be performed during a period of ordinary demand for the water system.
    - a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.
  - 4. Pitot readings are to be taken at the 2-1/2-inch orifice connection.
  - 5. The pitot reading is to range from 10 to 35 psig.
  - 6. Open additional hydrant outlets as needed to control pitot readings.
  - 7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.
- B. Flow Test Data Written Report:
  - 1. Flow data report is to be written in accordance with NFPA 291.
  - 2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.
- C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.
- D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying pressure gauges.
- E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

3.2 INSTALLATION OF FIRE-SUPPRESSION WATER-SERVICE PIPING

- A. Comply with requirements for fire-suppression water-service piping in Section 331415 "Site Water Distribution Piping."

### 3.3 INSTALLATION OF DOMESTIC WATER-SUPPLY CONNECTIONS

- A. Connect fire-suppression water piping to building's interior domestic water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 331415 "Site Water Distribution Piping."

### 3.4 INSTALLATION OF FIRE-SUPPRESSION PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
  - 1. Deviations from approved working plans for piping require written approval from AHJs. File written approval with Architect before deviating from approved working plans.
  - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of fire-suppression piping.
- C. Install seismic restraints on piping. Comply with NFPA standards requirements for seismic-restraint device materials and installation.
- D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install inspector's test connections in sprinkler system piping, complete with shutoff valve, and sized and located in accordance with NFPA 13.
- H. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and spill over floor drain or to exterior of building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for fire-suppression piping in accordance with NFPA standards. Comply with requirements for hanger materials in NFPA standards. In seismic-rated areas, refer

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to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

- M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe/sprinkler supply. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
- N. Pressurize and check dry-pipe standpipe or sprinkler system piping and air-pressure maintenance devices and air compressors.
- O. Fill wet-type fire-suppression system piping with water.
- P. Drain dry-type fire-suppression system piping.
  - 1. Install electric heating cables and pipe insulation on fire-suppression piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210500 "Common Work Results for Fire-Suppression Piping."

### 3.5 INSTALLATION OF PIPING JOINTS

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts in accordance with ASME B31.9.

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- G. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.
- K. Brazed Joints: Join copper tube and fittings in accordance with Copper Development Association's "Copper Tube Handbook," "Brazed Joints" chapter.
- L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.6 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS

- A. Install wall-type fire department connections.
- B. Install yard-type fire department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."
- C. Install automatic (ball-drip) drain valve at each check valve for fire department connection.

### 3.7 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.
- B. Install listed fire-suppression system shutoff valves in supervised open position, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. System Control Valves:

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1. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
2. Install dry-pipe valves with trim sets for air supply, drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
  - a. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14 to 60 psig adjustable range; and 175 psig maximum inlet pressure.
  - b. Install compressed-air-supply piping from building's compressed-air piping system.

D. Air Vent:

1. Provide at least one air vent at high point in each wet-pipe fire-suppression system in accordance with NFPA standards. Connect vent into top of fire-suppression piping.
2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
3. Pipe from outlet of air vent to drain.

3.8 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings symmetrically in center of acoustical ceiling panels within tolerance of 1/2 inch. Coordinate entire pattern of sprinkler locations with approved reflected ceiling plan.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.9 INSTALLATION OF NITROGEN GENERATOR WITH PURGE/VENT SYSTEM

- A. Install in accordance with manufacturer's written installation instructions.
- B. Locate purge vent/valve in accordance with manufacturer's written installation instructions.
- C. Route alarm signals in code-approved electrical conduit from nitrogen generator system control panel to the supervisory circuit of BAS.

3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping in accordance with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."



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- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Perform the following tests and inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect fire-suppression systems in accordance with NFPA standards.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Start and run air compressors.
  - 6. Coordinate with fire-alarm tests. Operate as required.
  - 7. Coordinate with fire-pump tests. Operate as required.
  - 8. Verify that equipment hose threads are same as local fire department equipment.
  - 9. Verify that sprinklers original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.
- C. Fire-suppression piping system will be considered defective if it does not pass tests and inspections.
- D. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.
- E. Prepare test and inspection reports.

3.12 CLEANING

- A. Clean dirt and debris from fire-suppression system piping, system control valves, sprinklers, and associated components.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.13 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain system control valves and pressure-maintenance pumps.

3.14 PIPING SCHEDULE

- A. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:

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1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  2. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  3. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- B. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 and Larger, to Be One of the Following:
1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  2. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  3. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
  4. Schedule 10 or engineered light-wall, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  5. Schedule 10 or engineered light-wall, steel pipe with plain ends; welding fittings; and welded joints.

3.15 SPRINKLER SCHEDULE

- A. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces and locations not generally exposed to view; and wax coated where exposed to acids, chemicals, or other corrosive fumes.
  2. Recessed Sprinklers: Bright chrome, with factory-painted white escutcheon.
  3. Flat Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
  4. Residential Sprinklers: Dull chrome.

END OF SECTION

## SECTION 211119 – FIRE DEPARTMENT CONNECTIONS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Exposed-type fire-department connections.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

### PART 2 - PRODUCTS

#### 2.1 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Elkhart Brass Mfg. Co., Inc.
  - 2. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
  - 3. Guardian Fire Equipment, Inc.
  - 4. Wilson & Cousins Inc.
- B. Standard: UL 405.
- C. Type: Exposed, projecting, for wall mounting.
- D. Pressure Rating: 175 psig minimum.

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- E. Body Material: Corrosion-resistant metal.
- F. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- G. Caps: Brass, lugged type, with gasket and chain.
- H. Escutcheon Plate: Round, brass, wall type.
- I. Outlet: Back, with pipe threads.
- J. Number of Inlets: Two.
- K. Escutcheon Plate Marking: Similar to "AUTO SPKR."
- L. Finish: Polished chrome plated.
- M. Outlet Size: NPS 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-type fire-department connections.
- B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION

## SECTION 220513 – COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

#### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

#### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

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2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Rotor: Random-wound, squirrel cage.
- E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating.
- G. Insulation: Class F.
- H. Code Letter Designation:
  - 1. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor

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insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

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SECTION 22017 – SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves without waterstop.
2. Sleeves with waterstop.
3. Sleeve-seal systems.
4. Grout.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATERSTOP

- A. Black-Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, with plain ends.
- B. Steel Sheet Sleeves: ASTM A653/A653M, 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVES WITH WATERSTOP

- A. Description: Manufactured galvanized steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Advance Products & Systems, LLC.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex Company (The).
  5. Proco Products, Inc.



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- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Designed to form a hydrostatic seal of 20 psig minimum.
  - 2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel or composite plastic.
  - 4. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating of length required to secure pressure plates to sealing elements.

## 2.4 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes through walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using grout, seal the space outside of sleeves in slabs and walls.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Extend sleeves installed in concealed interior partitions a minimum of 1-inch beyond finished wall surface.
  - 2. Cut sleeves to length in exposed locations for mounting flush with both surfaces where escutcheons are required.

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3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  4. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 07 92 00 "Joint Sealants."
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

### 3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeves.

### 3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 SLEEVE SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Exterior Concrete Walls above and below Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  2. Concrete Slabs-on-Grade:
    - a. Sleeves with waterstops.

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- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Interior Partitions:
  - a. Piping Smaller than NPS 6: Black-steel pipe sleeve without waterstop.
  - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

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SECTION 220518 – ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Escutcheons.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Cast-Brass Type: With rough brass finish and setscrew fastener.
- C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- D. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- E. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - d. Bare Piping in Unfinished Service Spaces or Equipment Rooms: One-piece cast brass with rough-brass finish.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION

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SECTION 220519 – METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Pressure gages.
4. Gage attachments.

B. Related Requirements:

1. Section 22 11 19 "Domestic Water Piping Specialties" for water meters.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

1.3 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Flo Fab Inc.
  - b. Miljoco Corporation.

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- c. [Tel-Tru Manufacturing Company.](#)
  - d. [WATTS; A Watts Water Technologies Company.](#)
  - e. [WIKA Instrument Corporation.](#)
  - f. [Weiss Instruments, Inc.](#)
  - g. [Weksler Glass Thermometer Corp.](#)
2. Standard: ASME B40.200.
  3. Case: Plastic; 6-inch nominal size.
  4. Case Form: Back angle unless otherwise indicated.
  5. Tube: Glass with magnifying lens and blue or red organic liquid.
  6. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F.
  7. Window: Glass or plastic.
  8. Stem: Aluminum or brass and of length to suit installation.
- a. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch, with ASME B1.1 screw threads.
  10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## 2.2 THERMOWELLS

### A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI Insert material.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

### B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.3 PRESSURE GAGES

### A. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. [Ametek U.S. Gauge.](#)
  - b. [Ashcroft Inc.](#)

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- c. [Flo Fab Inc.](#)
  - d. [Miljoco Corporation.](#)
  - e. [Palmer Wahl Instrumentation Group.](#)
  - f. [Tel-Tru Manufacturing Company.](#)
  - g. [Terice, H. O. Co.](#)
  - h. [WIKA Instrument Corporation.](#)
  - i. [Weiss Instruments, Inc.](#)
  - j. [Weksler Glass Thermometer Corp.](#)
- 2. Standard: ASME B40.100.
  - 3. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
  - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
  - 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
  - 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
  - 8. Pointer: Dark-colored metal.
  - 9. Window: Glass or plastic.
  - 10. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

## 2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.



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H. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.

I. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Suction and discharge of each domestic water pump.

### 3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

### 3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

### 3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:

1. Plastic case, compact-style, liquid-in-glass type.

B. Thermometer stems shall be of length to match thermowell insertion length.

### 3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping:

1. 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping:

1. 0 to 250 deg F.

### 3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages shall be the following:

1. Sealed, direct-mounted, plastic case.

### 3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service and Domestic Water Piping:

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1. 0 to 100 psi.

END OF SECTION

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SECTION 220523.12 – BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.
- C. WOG: Water, oil, gas.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of valve. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:

- 1. Domestic water valves intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded end valves.
- 2. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
- 3. ASME B16.34 for flanged and threaded end connections
- 4. ASME B31.9 for building services piping valves.

- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- E. Valve Sizes: Same as upstream piping unless otherwise indicated.

- F. Valve Actuator Type:

- 1. Hand Lever: For quarter-turn valves smaller than NPS 4.

- G. Valves in Insulated Piping:

- 1. Provide 2-inch extended neck stems.
- 2. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
- 3. Memory stops that are fully adjustable after insulation is applied.

2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Red-White Valve Corp.
  - f. Stockham; a Crane Co. brand.
  - g. WATTS; A Watts Water Technologies Company.
2. Standard: MSS SP-110; MSS SP-145.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Threaded or soldered.
7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

#### 3.2 INSTALLATION OF VALVES

- A. Install valves with unions at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.

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- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, provide the same types of valves with higher CWP ratings.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

### 3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
  - 1. Brass ball valves, two-piece with full port, and stainless steel trim. Provide with threaded or solder-joint ends.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Bronze ball valves, two-piece with full port, stainless-steel trim, and threaded or flanged ends.

END OF SECTION

SECTION 220523.14 – CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze, swing check valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. NBR: Nitrile butadiene rubber (also known as Buna-N).

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of valve. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, press connections, and weld ends.
3. Set check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:

- 1. Domestic water piping check valves intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372, or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded end valves.
- 2. ASME B16.22 for wrought copper solder joint.
- 3. ASME B31.9 for building services piping valves.

- C. AWWA Compliance: Comply with AWWA C606 for groove-end connections.

- D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- F. Valve Sizes: Same as upstream piping unless otherwise indicated.

- G. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE SWING CHECK VALVES

- A. Bronze, Swing Check Valves with Nonmetallic Disc, Class 125:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Crane Valves; a Crane Co. brand.
  - c. Lance Valves.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.



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- f. [Powell Valves.](#)
- g. [Red-White Valve Corp.](#)
- h. [Stockham; a Crane Co. brand.](#)

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B62, bronze.
- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: PTFE.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. Install valves so that stems are horizontal or slope upward from centerline of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.
- H. Check Valves: Install check valves for proper direction of flow.

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1. Swing Check Valves: In horizontal position with hinge pin level.

- I. Adhere to manufacturer's installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

- a. NPS 2 and Smaller: Bronze, swing check valves with nonmetallic disc.

- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

- C. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:

1. Bronze, swing check valves with nonmetallic disc, Class 125, with soldered or threaded end connections.

END OF SECTION

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SECTION 220529 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Metal framing systems.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe-positioning systems.

B. Related Requirements:

1. Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
  2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

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2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

## 2.2 METAL FRAMING SYSTEMS

### A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc or hot-dip galvanized.

## 2.3 THERMAL HANGER-SHIELD INSERTS

### A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Carpenter & Paterson, Inc.
2. ERICO International Corporation.
3. National Pipe Hanger Corporation.
4. Pipe Shields Inc.
5. Piping Technology & Products, Inc.
6. Rilco Manufacturing Co., Inc.
7. Value Engineered Products, Inc.

### B. Insulation-Insert Material: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

### C. For Clamped Systems: Insert and shield shall cover entire circumference of pipe.

### D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

### E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

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2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Indoor Applications: Zinc-coated or stainless steel.

2.5 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

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- E. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

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5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### 3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.4 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- F. Use thermal hanger-shield inserts for insulated piping and tubing.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

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2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
    2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
    3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
    4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
    5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
  - J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
    2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
    3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
    4. C-Clamps (MSS Type 23): For structural shapes.
    5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
    6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  - K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
    2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
    3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
  - L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
  - M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
  - N. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION



SECTION 220548.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Elastomeric hangers.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

PART 2 - PRODUCTS

2.1 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Ace Mountings Co., Inc.
    - b. Isolation Technology, Inc.
    - c. Kinetics Noise Control, Inc.
    - d. Mason Industries, Inc.
    - e. Novia; A Division of C&P.
    - f. Vibration Eliminator Co., Inc.
    - g. Vibration Mountings & Controls, Inc.

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2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

- A. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION

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SECTION 220553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product indicated. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick.
2. Letter and Background Color: White letters on black background.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number.

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2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
  - 1. Pipe size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
  - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.3 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass beaded chain or S-hook.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

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3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within 3 ft. of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 3. Within 3 ft. of equipment items and other points of origination and termination.
  - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
  - 1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  - 2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
  - 3. Domestic Hot-Water Return Piping: White letters on an ANSI Z535.1 safety-green background.
  - 4. Sanitary Waste and Storm Drainage Piping: White letters on a black background.
  - 5. Radon Vent Piping: White letters on a black background.s

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3.5 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
  - 1. Valve-Tag Size and Shape: 1-1/2 inches, round.
  - 2. Valve-Tag Colors: Natural with black letters.

END OF SECTION

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SECTION 220593 – TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. TAB of domestic water system.
  - 2. TAB of plumbing equipment:
    - a. Domestic hot-water in-line circulation pumps.
- B. Related Requirements:
  - 1. Section 23 05 93 “Testing, Adjusting, and Balancing for HVAC.”

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

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- C. Contract Documents Examination Report: Within 90 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- D. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- E. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- F. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- G. Certified TAB reports.
- H. Sample report forms.
- I. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB or TABB:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.
- E. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."
- F. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.



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PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine equipment performance data, including pump curves.
  - 1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.
- E. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- F. Examine test reports specified in individual system and equipment Sections.
- G. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- H. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- I. Examine system pumps to ensure absence of entrained air in the suction piping.
- J. Examine operating safety interlocks and controls on plumbing equipment.
- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:

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1. Equipment and systems to be tested.
  2. Strategies and step-by-step procedures for balancing the systems.
  3. Instrumentation to be used.
  4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
1. Domestic Water System:
    - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
    - b. Water heaters are installed and functioning.
    - c. Piping is complete and all points of outlet are installed.
    - d. Water treatment is complete.
    - e. Systems are flushed, filled, and air purged.
    - f. Strainers are clean.
    - g. Shutoff and balance valves are 100 percent open.
    - h. Hot-water circulating pumps are operational and proper rotation is verified.
    - i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
    - j. Suitable access to balancing devices and equipment is provided.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance," ASHRAE 111, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
  1. Motors.
  2. Domestic water in-line pumps.
  3. Domestic water heaters.

### 3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
  - 1. Check expansion tank for proper setting.
  - 2. Check water heater for proper discharge temperature setting.
  - 3. Check remotest point of outlet for adequate pressure.
  - 4. Check flow-control valves for proper position.
  - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
  - 6. Verify that motor controllers are equipped with properly sized thermal protection.
  - 7. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- F. Check settings and operation of each safety valve. Record settings.

### 3.6 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

- A. Balance system with manual or automatic balancing valves by setting at design flow.
  - 1. Measure flow in main and branch pipes.
  - 2. Adjust main and branch balance valves for design flow.
  - 3. Re-measure each main and branch after all have been adjusted.
- B. Adjust pump to deliver total design flow.
  - 1. Measure pump TDH as follows:
    - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    - c. Convert pressure to head and correct for differences in gauge heights.
    - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
  - 2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
  - 3. Mark final settings and verify that all memory stops have been set.

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4. Verify final system conditions as follows:
  - a. Re-measure and confirm that total flow is within design.
  - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
  - c. Mark final settings.

### 3.7 PROCEDURES FOR WATER HEATERS

#### A. Electric Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

#### B. Gas-Fired Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Fuel Consumption: If fuel supply is equipped with flow meter, measure and record consumption.
7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data.

### 3.8 TOLERANCES

#### A. Set plumbing system's flow rates within the following tolerances:

1. Domestic Water Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm, within 10 percent.

### 3.9 FINAL REPORT

#### A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

#### B. Final Report Contents: In addition to certified field-report data, include the following:

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1. Pump curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB specialist.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents, including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Notes to explain why certain final data in the body of reports vary from indicated values.
  14. Test conditions for pump performance forms, including the following:
    - a. Settings for pressure controller(s).
    - b. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:
1. Flow rates.
  2. Pipe and valve sizes and locations.
  3. Balancing stations.
  4. Position of balancing devices.
- E. Gas-Fired Water Heaters Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.

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- e. Manufacturer's serial number.
  - f. Fuel type in input data.
  - g. Output capacity in Btu/h.
  - h. Ignition type.
  - i. Burner-control types.
  - j. Motor horsepower and speed.
  - k. Motor volts, phase, and hertz.
  - l. Motor full-load amperage and service factor.
  - m. Sheave make, size in inches, and bore.
  - n. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
  - b. Entering-water temperature in deg F.
  - c. Leaving-water temperature in deg F.
  - d. Low-fire fuel input in Btu/h.
  - e. High-fire fuel input in Btu/h.
  - f. High-temperature-limit setting in deg F.
  - g. Operating set point in Btu/h.
  - h. Heating value of fuel in Btu/h.
- F. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
- a. System identification.
  - b. Location.
  - c. Model number and unit size.
  - d. Manufacturer's serial number.
  - e. Output capacity in Btu/h.
  - f. Number of stages.
  - g. Connected volts, phase, and hertz.
  - h. Rated amperage.
2. Test Data (Indicated and Actual Values):
- a. Heat output in Btu/h.
  - b. Entering-water temperature in deg F.
  - c. Leaving-water temperature in deg F.
  - d. High-temperature-limit setting in deg F.
  - e. Operating set point in deg F.
  - f. Voltage at each connection.
  - g. Amperage for each phase.
- G. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:
1. Unit Data:

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- a. Unit identification.
  - b. Location.
  - c. Service.
  - d. Make and size.
  - e. Model number and serial number.
  - f. Water flow rate in gpm.
  - g. Water-pressure differential in feet of head or psig.
  - h. Required net positive suction head in feet of head or psig.
  - i. Pump speed.
  - j. Impeller diameter in inches.
  - k. Motor make and frame size.
  - l. Motor horsepower and rpm.
  - m. Voltage at each connection.
  - n. Amperage for each phase.
  - o. Full-load amperage and service factor.
  - p. Seal type.
2. Test Data (Indicated and Actual Values):
  - a. Static head in feet of head or psig.
  - b. Pump shutoff pressure in feet of head or psig.
  - c. Actual impeller size in inches.
  - d. Full-open flow rate in gpm.
  - e. Full-open pressure in feet of head or psig.
  - f. Final discharge pressure in feet of head or psig.
  - g. Final suction pressure in feet of head or psig.
  - h. Final total pressure in feet of head or psig.
  - i. Final water flow rate in gpm.
  - j. Voltage at each connection.
  - k. Amperage for each phase.

H. Instrument Calibration Reports:

1. Report Data:
  - a. Instrument type and make.
  - b. Serial number.
  - c. Application.
  - d. Dates of use.
  - e. Dates of calibration.

END OF SECTION

## SECTION 220719 – PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic recirculating hot-water piping.
  - 4. Roof drains and rainwater leaders.
- B. Related Sections:
  - 1. Section 22 42 16.13 “Commercial Lavatories” and Section 22 42 16.16 “Commercial Sinks” for protective shielding coverage for supplies and drains for handicapped-accessible fixtures.

#### 1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any). On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Sustainable Design Submittals:
  - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
  - 2. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
  - 3. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
- D. Insulation Schedule: Identify type of material, thickness, vapor barrier provision, and where required field-applied jacket to be provided for each system application.
- E. Provide piping layouts, including pipe size and insulation requirements, to General Contractor for inclusion in project coordination drawings.

#### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.



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1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General" and "Indoor Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

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- D. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- E. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. K-Flex USA.
- F. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Manson Insulation Inc.
    - d. Owens Corning.
  - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ or with factory-applied ASJ-SSL.
  - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
  - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.3 INSULATING CEMENTS

- A. Glass-Fiber Insulating Cement: Comply with ASTM C195.
- B. Glass-Fiber Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

## 2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Solvent-based adhesive.
  - 1. Adhesive: As recommended by flexible elastomeric manufacturer and with a VOC content of 80 g/L or less.

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2. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
  3. Wet Flash Point: Below 0 deg F.
  4. Service Temperature Range: 40 to 200 deg F.
- C. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Adhesive: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
1. Verify adhesives have a VOC content of 80 g/L or less.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.

## 2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  2. Service Temperature Range: 0 to plus 180 deg F.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  2. Service Temperature Range: 0 to plus 180 deg F.

## 2.6 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
1. Permanently flexible, elastomeric sealant.
  2. Service Temperature Range: Minus 58 to plus 176 deg F.
  3. Color: White or gray.
  4. Verify sealant has a VOC content of 420 g/L or less.

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C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: White.
4. Verify sealant has a VOC content of 420 g/L or less.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
  - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor applications.

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1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

2.10 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- B. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

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- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

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- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, and Unions:
  - 1. Install insulation over fittings, valves, strainers, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter,

whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Fittings and Elbows:
1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Valves and Pipe Specialties:
1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
  2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.



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4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 INSTALLATION OF GLASS-FIBER INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

#### C. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.8 INSTALLATION OF FIELD-APPLIED JACKETS

#### A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

### 3.9 FINISHES

#### A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

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3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. NPS 1 and Smaller: Insulation is the following:
    - a. Flexible Elastomeric: 1/2 inch thick.
  - 2. NPS 1-1/4 and Larger: Insulation is the following:
    - a. Flexible Elastomeric: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 and Smaller: Insulation is the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 2. NPS 1-1/2 and Larger: Insulation is the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- C. Stormwater and Overflow:
  - 1. All Pipe Sizes: Insulation is the following:
    - a. Flexible Elastomeric: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies:
  - 1. All Pipe Sizes: Insulation is the following:
    - a. Flexible Elastomeric: 1 inch thick.

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3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
  - 1. PVC: 20 mils thick.

END OF SECTION

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SECTION 220800 – COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Cx process requirements for the following plumbing systems, assemblies, and equipment:
  - 1. Domestic hot- and cold-water piping.
  - 2. Sanitary waste and vent piping.
  - 3. Storm drainage piping.
  - 4. Plumbing pumps.
  - 5. Plumbing equipment.
- B. Related Requirements:
  - 1. Section 01 91 13 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
  - 2. Section 23 08 00 "Commissioning of HVAC."

1.2 DEFINITIONS

- A. Cx: Commissioning, as defined in Section 01 91 13 "General Commissioning Requirements."
- B. CxA: Commissioning Authority, as defined in Section 01 91 13 "General Commissioning Requirements."
- C. IAPMO: International Association of Plumbing and Mechanical Officials.
- D. IgCC: International Green Construction Code.
- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For plumbing testing technician.
- C. Construction Checklists:
  - 1. Draft Cx plan, including draft construction checklists to be prepared by CxA under Section 01 91 13 "General Commissioning Requirements." Contractor is to review

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Construction Checklist in accordance with requirements in Section 01 91 13 "General Commissioning Requirements" and ASHRAE 202 and to resolve any issues with the CxA.

- D. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Contractor, provide the following:
1. Equipment/instrument identification number.
  2. Planned Cx application or use.
  3. Manufacturer, make, model, and serial number.
  4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
  5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:
    - a. Instrument or tool identification number.
    - b. Equipment schedule designation of equipment for which the instrument or tool is required.
    - c. Manufacturer, make, model, and serial number.
    - d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

1.4 QUALITY ASSURANCE

- A. Plumbing Testing Technician Qualifications: Technicians to perform plumbing Construction Checklist verification tests. Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
1. Journey level or equivalent skill level with knowledge of plumbing system, electrical concepts, and building operations.
- B. Testing Equipment and Instrumentation Quality and Calibration:
1. Capable of testing and measuring performance within the specified acceptance criteria.
  2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
  3. Be maintained in good repair and operating condition throughout duration of use on Project.
  4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Cx PROCESS

- A. Perform Cx process for plumbing systems in accordance with:

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1. IgCC, which requires compliance with ASHRAE 202.

### 3.2 CONSTRUCTION CHECKLISTS

- A. Preliminary detailed construction checklists are to be prepared under Section 01 91 13 "General Commissioning Requirements" for each plumbing system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in IgCC. Contractor performs the following:
  1. Review plumbing preliminary construction checklists and provide written comments on Construction Checklist items where appropriate.
  2. Return preliminary Construction Checklist with review comments within 10 days of receipt.
  3. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
  4. Use only construction checklists marked "Approved for Use, (date)." Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.
- B. Systems Required to Be Commissioned under IgCC:
  1. Domestic hot-water systems and controls.
- C. Additional Systems Required to Be Commissioned:
  1. Domestic water piping, including the following:
    - a. Domestic cold- and hot-water piping, fittings, and specialties inside the building.
    - b. Pumps, motors, accessories, and controls.
    - c. Sleeves and sleeve seals.
    - d. Meters and gauges.
    - e. General-duty and specialty valves.
    - f. Hangers and supports.
    - g. Vibration isolation.
  2. Sanitary waste and vent piping, including the following:
    - a. Gravity sewerage piping, fittings, and specialties.
    - b. Drains.
    - c. Sleeves and sleeve seals.
    - d. Hangers and supports.
  3. Storm-water piping, including the following:
    - a. Drainage piping, fittings, and specialties.
    - b. Drains.
    - c. Sleeves and sleeve seals.
    - d. Hangers and supports.
  4. Plumbing fixtures, including the following:

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- a. Water closets, supports and connections, supplies, and flush valves.
- b. Urinals, supports and connections, supplies, and flush valves.
- c. Lavatories, supports, supplies, drain connections, and faucets.
- d. Sinks, supports, supplies, drain connections, and faucets.
- e. Electric water coolers, supplies, and drainage connections.

3.3 Cx TESTING PREPARATION

- A. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that plumbing system instrumentation and control systems have been completed and calibrated, point-to-point checkout has been successfully completed, and systems are operating in accordance with their design sequence of operation, Contract Documents, and approved submittals. Certify that all sensors are operating within specified accuracy and that all systems are set to and maintaining set points as required by the design documents.
- C. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.4 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
  - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
  - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
  - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.

3.5 Cx TESTS COMMON TO PLUMBING SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.

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- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response compared to acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 22 Sections specifying plumbing systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
  - 1. Cx Construction Checklist verification tests.
  - 2. Cx Construction Checklist verification test demonstrations.

END OF SECTION



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SECTION 221116 – DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. PEX tube and fittings.
4. Piping joining materials.

B. Related Requirements:

1. Section 33 14 15 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. Pipe and tube.
2. Fittings.
3. Joining materials.
4. Transition fittings.

C. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

D. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.
4. Health Product Declaration: For each product.
5. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

E. Provide piping layouts, including pipe size and insulation requirements, to General Contractor for inclusion in project coordination drawings.

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1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. System purging and disinfecting activities report.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- C. Wrought Copper Unions: ASME B16.22.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe:
  - 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard-Pattern, Mechanical-Joint Fittings:
  - 1. AWWA C110/A21.10, ductile or gray iron.
  - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 PEX TUBE AND FITTINGS

- A. Tube Material: PEX plastic according to ASTM F876 and ASTM F877.
- B. Fittings: ASTM F1807, metal insert and copper crimp rings.

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2.5 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B32, lead-free alloys.
- B. Flux: ASTM B813, water flushable.
- C. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building-service piping, NPS 4 and larger, shall be the following:
  - 1. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
- D. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
  - 1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- E. Aboveground domestic water piping, shall be the following:
  - 1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
- F. Under-building slab trap primer piping shall be the following:
  - 1. PEX tube with crimped joints.

3.2 EARTHWORK

- A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction

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loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install valves according to the following:
  - 1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
  - 2. Section 22 05 23.14 "Check Valves for Plumbing Piping."
- E. Install domestic water piping level without pitch and plumb.
- F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install PEX tubing with loop at each change of direction of more than 90 degrees.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gauges on suction and discharge piping for each plumbing pump. Comply with requirements for pressure gauges in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."
- R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."

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- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Joints for PEX Tubing, ASTM: Join according to ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.

### 3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

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3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.8 ADJUSTING

- A. Perform the following adjustments before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

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3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
  - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
  - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Hydrostatic testing and documentation of test results for polypropylene piping to be in accordance with the manufacturer's instructions and submitted to the manufacturer upon successful completion per warranty requirements.
- f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- g. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

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3.10 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION



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SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers for domestic water piping.
6. Hose stations.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer systems.
12. Water meters.

B. Related Requirements:

1. Section 22 05 19 "Meters and Gauges for Plumbing Piping" for thermometers and pressure gauges in domestic water piping.
2. Section 22 47 16 "Pressure Water Coolers" for water filters for water coolers.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Shop Drawings: For domestic water piping specialties.
  1. Include diagrams for power, signal, and control wiring.
- D. Provide specialties cut sheets to General Contractor for inclusion in project coordination drawings. Include all specialties dimensions, noting manufacturer's clearance requirements, as well as location and sizes of all equipment connections.

1.3 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Cash Acme Plumbing Products; an RWC brand.
  - c. FEBCO; A WATTS Brand.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Zurn Industries, LLC.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers (BFP):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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- a. [Ames Fire & Waterworks; A Watts Water Technologies Company.](#)
  - b. [Apollo Valves; a part of Aalberts Integrated Piping Systems.](#)
  - c. [FEBCO; A WATTS Brand.](#)
  - d. [WATTS; A Watts Water Technologies Company.](#)
  - e. [Zurn Industries, LLC.](#)
2. Standard: ASSE 1013.
  3. Operation: Continuous-pressure applications.
  4. Capacity and Characteristics: As scheduled on Drawings.
  5. Body: Bronze or stainless steel for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
  6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  7. Configuration: Designed for horizontal, straight-through flow.
  8. Accessories:
    - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

## 2.5 BALANCING VALVES

### A. Automatic Flow Control Balancing Valves:

1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. [Caleffi North America.](#)
  - b. [IMI Hydronic Engineering Inc.](#)
  - c. [ThermOmegaTech.](#)
2. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.
3. Pressure Rating: 200 psig.
4. Size: NPS 2 or smaller.
5. Body: Stainless steel or brass.
6. Flow Cartridge: Stainless steel or antiscall polymer.
7. End Connections: Threaded or solder joint.

## 2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

### A. Primary, Thermostatic, Water Mixing Valves (TMV):

1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. [Acorn Engineering Company; a Division of Morris Group International.](#)

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- b. [Apollo Valves; a part of Aalberts Integrated Piping Systems.](#)
  - c. [Cash Acme Plumbing Products; an RWC brand.](#)
  - d. [Lawler Manufacturing Company, Inc.](#)
  - e. Leonard Valve Company.
  - f. [POWERS; A WATTS Brand.](#)
  - g. [Symmons Industries, Inc.](#)
  - h. [WATTS; A Watts Water Technologies Company.](#)
  - i. [Zurn Industries, LLC.](#)
2. Standard: ASSE 1017.
  3. Pressure Rating: 125 psig minimum unless otherwise indicated.
  4. Type: Cabinet-type, thermostatically controlled, water mixing valve.
  5. Material: Bronze body with corrosion-resistant interior components.
  6. Connections: Threaded union inlets and outlet.
  7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
  8. Capacity and Characteristics: As scheduled on Drawings.
  9. Valve Finish: Rough bronze.
  10. Piping Finish: Copper.
  11. Cabinet: Factory fabricated, steel, for surface mounting and with hinged, steel door.

## 2.7 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.020 inch.
  - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
6. Drain: Factory-installed, hose-end drain valve.

## 2.8 HOSE STATIONS

### A. Hot- and Cold-Water Hose Stations (HS):

1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. [ARCHON Industries, Inc.](#)
  - b. [Armstrong International, Inc.](#)
  - c. [Cooney Brothers, Inc.](#)
  - d. [DynaFluid Ltd.](#)

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- e. Leonard Valve Company.
  - f. [Strahman Valves, Inc.](#)
  - g. [T&S Brass and Bronze Works, Inc.](#)
- 2. Standard: ASME A112.18.1.
  - 3. Faucet Type: Blending valve.
  - 4. Cabinet: Stainless steel enclosure with exposed valve handles, hose connection, and hose rack. Include thermometer in front.
  - 5. Hose-Rack Material: Stainless steel.
  - 6. Body Material: Bronze with stainless steel wetted parts.
  - 7. Body Finish: Rough bronze.
  - 8. Mounting: Wall, with reinforcement.
  - 9. Supply Fittings: Two NPS 3/4 or ball valves and check valves and NPS 3/4 copper, water tubing. Omit check valves if check stops are included with fitting.
  - 10. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 25 feet long.
  - 11. Nozzle: With hand-squeeze, on-off control.
  - 12. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

2.9 HOSE BIBBS

A. Hose Bibbs (HB):

- 1. Standard: ASME A112.18.1 for sediment faucets.
- 2. Body Material: Bronze.
- 3. Seat: Bronze, replaceable.
- 4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
- 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
- 6. Pressure Rating: 125 psig.
- 7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
- 8. Finish for Equipment Rooms or Service Areas: Rough bronze, or chrome or nickel plated.
- 9. Finish for Finished Rooms: Chrome or nickel plated.
- 10. Operation for Equipment Rooms or Service Areas: Wheel handle or operating key.
- 11. Operation for Finished Rooms: Operating key.
- 12. Include operating key with each operating-key hose bibb.
- 13. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants (NFWH):

- 1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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- a. [Jay R. Smith Mfg Co; a division of Morris Group International.](#)
  - b. Josam Company.
  - c. [MIFAB, Inc.](#)
  - d. [Prier Products, Inc.](#)
  - e. [WATTS; A Watts Water Technologies Company.](#)
  - f. [Woodford Manufacturing Company.](#)
  - g. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
  3. Pressure Rating: 125 psig.
  4. Operation: Loose key.
  5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
  6. Inlet: NPS 3/4 or NPS 1.
  7. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  8. Box: Deep, flush mounted with cover.
  9. Box and Cover Finish: Polished nickel bronze.

B. Moderate-Climate Wall Hydrants (WH):

1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. [Jay R. Smith Mfg Co; a division of Morris Group International.](#)
  - b. [MIFAB, Inc.](#)
  - c. [Prier Products, Inc.](#)
  - d. [WATTS; A Watts Water Technologies Company.](#)
  - e. [Woodford Manufacturing Company.](#)
  - f. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet, Exposed:
  - a. With integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
  - b. Garden-hose thread complying with ASME B1.20.7.
7. Nozzle and Wall-Plate Finish: Polished nickel bronze or polished chrome.
8. Operating Key(s): One with each wall hydrant.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.

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2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters (WHA):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. AMTROL, Inc.
  - b. Jay R. Smith Mfg Co; a division of Morris Group International.
  - c. Josam Company.
  - d. MIFAB, Inc.
  - e. Precision Plumbing Products.
  - f. Sioux Chief Manufacturing Company, Inc.
  - g. WATTS; A Watts Water Technologies Company.
  - h. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Piston or diaphragm.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems (TPA):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Precision Plumbing Products.
  - b. Sioux Chief Manufacturing Company, Inc.

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- c. Zurn Industries, LLC.
- 2. Standard: ASSE 1044.
- 3. Inlet Size: NPS 3/4, ASTM B88, Type L; copper, water tubing.
- 4. Cabinet: Surface- or recessed-mounted steel box with steel cover, as specified on Drawings.
- 5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120 V ac power.
  - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 6. Vacuum Breaker: ASSE 1001.
- 7. Number Outlets: As scheduled on Drawings.
- 8. Size Outlets: NPS 1/2.

2.14 WATER METERS

- A. Water meter shall be furnished and installed by local water utility company: Portland Water District (Tel: 207-774-5961).
- B. Contractor shall provide pipe flanges and spool section at water service entrance as directed by utility company, and shall contact utility company to schedule meter installation.
- C. Water meter shall be provided with pulse output for connection to building DDC system under Section 23 09 23 "Direct Digital Control System for HVAC."
- D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- B. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.



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- C. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Y-Pattern Strainers: For water, install on supply side of each pump.
- E. Hose Stations: Install with check stops or shutoff valves on inlets and with thermometer on outlet.
  - 1. Install cabinet-type units surface mounted on wall as specified. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 00 "Rough Carpentry."
- F. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- G. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- H. Install water meters in accordance with requirements of municipal water department and manufacturer's written instructions. Install meter on incoming water service.

### 3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

### 3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 26 05 23 "Control-Voltage Electrical Power Cables."

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3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Backflow preventers.
  - 2. Temperature-actuated, water mixing valves.
  - 3. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

- A. Set field-adjustable flow set points of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- C. Adjust each reduced-pressure-principle backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

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SECTION 221123.21 – INLINE, DOMESTIC-WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. In-line, sealless centrifugal pumps.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Provide equipment cut sheets to General Contractor for inclusion in project coordination drawings. Include all equipment dimensions, noting manufacturer's clearance requirements, as well as location and sizes of all equipment connections.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written instructions for handling.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: UL 778 for motor-operated water pumps.
- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Flo Fab Inc.
  - 2. Grundfos Pumps Corporation.
  - 3. Taco Comfort Solutions.
  - 4. WILO USA LLC - WILO Canada Inc.
- C. Capacities and Characteristics: As scheduled on Drawings.
- D. Pump Construction:
  - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
  - 2. Minimum Working Pressure: 125 psig.
  - 3. Maximum Continuous Operating Temperature: 220 deg F.
  - 4. Casing: Stainless steel, with threaded or companion-flange connections.
  - 5. Impeller: Plastic composite or stainless steel.
  - 6. Motor: Single speed.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

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2.4 CONTROLS

- A. Provide controls as specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.
  - 1. Comply with requirements for vibration isolation devices specified in Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
  - 2. Comply with requirements for hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 22 11 19 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:
  - 1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
  - 2. Section 22 05 23.14 "Check Valves for Plumbing Piping."
  - 3. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tappings where

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provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

3.4 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.
    - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - c. Verify that pump is rotating in the correct direction.
  - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 6. Start motor.
  - 7. Open discharge valve slowly.
  - 8. Adjust temperature settings on thermostats.

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3.7 ADJUSTING

- A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.

END OF SECTION

## SECTION 221313 - FACILITY SANITARY SEWERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless cast-iron soil pipe and fittings.
3. Ductile-iron, gravity sewer pipe and fittings.
4. Ductile-iron, pressure pipe and fittings.
5. ABS pipe and fittings.
6. PVC pipe and fittings.
7. Fiberglass pipe and fittings.
8. Concrete pipe and fittings.
9. Nonpressure-type transition couplings.
10. Pressure-type pipe couplings.
11. Expansion joints and deflection fittings.
12. Backwater valves.
13. Cleanouts.
14. Encasement for piping.
15. Manholes.
16. Concrete.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For the following:
  1. Pipe and fittings.
  2. Non-pressure and pressure couplings
  3. Sewer manholes.
- C. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.



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1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Certificates: For each type of pipe and fitting.
- C. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Architect and Owner no fewer than five business days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of service without Owner's written permission.

1.7 QUALITY ASSURANCE

- A. Products, materials, and installation must comply with the Greater Augusta Utility District’s Construction Requirements and Procedures.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A74, Service and Extra-Heavy classes.
- B. Gaskets: ASTM C564, rubber.
- C. Calking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A888 or CISPI 301.
- B. Cast-Iron, Shielded Couplings:

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1. Description: ASTM C1277 with ASTM A48/A48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C564, rubber sleeve with integral, center pipe stop.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ANACO-Husky.
  - b. Charlotte Pipe and Foundry Company.
  - c. Clamp-All Corp.
  - d. Dallas Specialty & Mfg. Co.
  - e. MG Piping Products Company.
  - f. Mission Rubber Company, LLC; a division of MCP Industries.
  - g. Tyler Pipe; a subsidiary of McWane Inc.

2.3 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

- A. Pipe: ASTM A746, for push-on joints.
- B. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, for push-on joints.
- C. Compact Fittings: AWWA C153/A21.53, ductile iron, for push-on joints.
- D. Gaskets: AWWA C111/A21.11, rubber.

2.4 PVC PIPE AND FITTINGS

- A. PVC Type PSM Sewer Piping:
  1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
  2. Fittings: ASTM D3034, PVC with bell ends.
  3. Gaskets: ASTM F477, elastomeric seals.

2.5 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
  1. For Cast-Iron Soil Pipes: ASTM C564, rubber.
  2. For Concrete Pipes: ASTM C443, rubber.
  3. For Fiberglass Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
  4. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
  5. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

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C. Shielded, Flexible Couplings:

1. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Cascade Waterworks Mfg. Co.
  - b. Dallas Specialty & Mfg. Co.
  - c. Mission Rubber Company, LLC; a division of MCP Industries.

D. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Fernco Inc.
  - b. Logan Clay Pipe.
  - c. Mission Rubber Company, LLC; a division of MCP Industries.

2.6 ENCASEMENT FOR CAST IRON AND DUCTILE IRON PIPING AND MANHOLES

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Tube.
- D. Color: Black.
- E. Manhole Wrap: 60-mil, self-shrinking, stretchable, self-adhesive, nonhardening, butyl rubber sealant, 6-inches to 12-inches wide, specifically intended for use to prevent water infiltration at manhole joints.

2.7 MANHOLES

- A. Standard Precast Concrete Manholes:
  1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
  2. Diameter: 48 inches minimum unless otherwise indicated.
  3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.

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4. Base Section: 6-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: Of thickness and length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: FRP ladder or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 4- to 8-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.
12. Wrap manhole joints with butyl rubber sealant specifically intended for use on manholes.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser, with 4-inch-minimum-width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A48/A48M, Class 35 gray iron unless otherwise indicated.

2.8 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350, and the following:

1. Cement: ASTM C150/C150M, Type II.
2. Fine Aggregate: ASTM C33/C33M, sand.
3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
  - a. Invert Slope: 2 percent through manhole.

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2. Benches: Concrete, sloped to drain into channel.
  - a. Slope: As indicated.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
  1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
  2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

#### 3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:
  1. Install piping pitched down in direction of flow, at minimum slope of 0.5 percent unless otherwise indicated.
  2. Install piping as indicated.
  3. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  4. Install ductile-iron, gravity sewer piping according to ASTM A746.
  5. Install PVC Type PSM sewer piping according to ASTM D2321 and ASTM F1668.
- G. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A674 or AWWA C105/A21.5:

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1. Hub-and-spigot, cast-iron soil pipe.
- H. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
  2. Join PVC Type PSM sewer piping according to ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasket joints.
  3. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
    - a. Shielded flexible couplings for pipes of same or slightly different OD.
    - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

### 3.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 2 inches above finished surface elsewhere unless otherwise indicated.

### 3.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

### 3.6 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."

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B. Make connections to existing piping and underground manholes.

1. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.7 IDENTIFICATION

A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use detectable warning tape over piping and over edges of underground manholes.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Notify City of Augusta Public Works Department at least 48 hours prior to backfilling to allow for inspection at piping systems.
2. Submit separate report for each system inspection.
3. Defects requiring correction include the following:
  - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
  - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
  - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
  - d. Infiltration: Water leakage into piping.
  - e. Exfiltration: Water leakage from or around piping.
4. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
5. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
  - a. Test plastic gravity sewer piping according to ASTM F1417.
6. Manholes: Perform hydraulic test according to ASTM C969.

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- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

- A. Clean dirt and superfluous material from interior of piping. Flush with water.

END OF SECTION



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SECTION 221316 – SANITARY WASTE AND VENT AND RADON PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. PVC pipe and fittings.
4. Specialty pipe fittings.

B. Related Requirements:

1. Section 22 13 13 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product. On data submittal sheets where more than one product is to be described, clearly annotate which product(s) is to be supplied.

C. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

D. Piping Schedule: Identify type of material, fittings, and joining method to be used for each piping application and size range.

E. Provide piping layouts, including pipe size and insulation requirements, to General Contractor for inclusion in project coordination drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10 ft. head of water.

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2. Radon Piping: 10 ft. head of water.

## 2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

## 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. AB & I Foundry; a part of the McWane family of companies.
  2. Charlotte Pipe and Foundry Company.
  3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
  1. Marked with CISPI collective trademark.
  2. ASTM A74, service cast iron.
- C. Gaskets: ASTM C564, rubber.

## 2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. AB & I Foundry; a part of the McWane family of companies.
  2. Charlotte Pipe and Foundry Company.
  3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
  1. Marked with CISPI collective trademark.
  2. ASTM A888 or CISPI 301.
- C. Heavy-Duty, Hubless-Piping Couplings:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. AB & I Foundry; a part of the McWane family of companies.
    - b. ANACO-Husky.
    - c. Charlotte Pipe and Foundry Company.

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- d. [Clamp-All Corp.](#)
  - e. [Dallas Specialty & Mfg. Co.](#)
  - f. [Ideal Tridon Group.](#)
  - g. [MIFAB, Inc.](#)
  - h. [Mission Rubber Company, LLC; a division of MCP Industries.](#)
  - i. [Tyler Pipe; a subsidiary of McWane Inc.](#)
2. Standards: ASTM C1277 and ASTM C1540.
  3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

## 2.5 PVC PIPE AND FITTINGS

- A. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. [Charlotte Pipe and Foundry Company.](#)
  2. [GF Piping Systems.](#)
  3. [JM Eagle.](#)
  4. Mueller Industries, Inc.
  5. [National Pipe and Plastic, Inc.](#)
  6. [North America Pipe Corporation.](#)
  7. [Rocky Mountain Colby Pipe Company.](#)
- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
  1. [Verify adhesive primer has a](#) VOC content of 550 g/L or less.
- F. Solvent Cement: ASTM D2564.
  1. [Verify solvent cement has a](#) VOC content of 510 g/L or less.

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

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3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. Make changes in direction for soil and waste drainage and vent and radon piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- J. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.

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- K. Install soil, waste, vent, and radon piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
  - 3. Vent and Radon Piping: One percent down toward vertical fixture vent or toward vent stack or towards radon pit.
- L. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- M. Install aboveground PVC piping in accordance with ASTM D2665.
- N. Install underground PVC piping in accordance with ASTM D2321.
- O. Install engineered soil and waste and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- P. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    - b. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 22 13 19.13 "Sanitary Drains."
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

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1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hubless, Cast-Iron Soil Piping Coupled Joints:
  1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
  1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

### 3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment".
  1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  3. Vertical Piping: MSS Type 8 or Type 42 clamps.
  4. Install individual, straight, horizontal piping runs:
    - a. 100 Ft. and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.
  5. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
  6. Base of Vertical Piping: MSS Type 52 spring hangers.
- B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- E. Support vertical runs of cast-iron soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

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- F. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
  - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Comply with requirements for drains specified in Section 22 13 19.13 "Sanitary Drains."
  - 6. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

### 3.6 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

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- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.
  5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent and radon piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste, vent, and radon piping installation.



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3.9 PIPING SCHEDULE

- A. Aboveground, soil, waste and vent piping NPS 4 and smaller are to be any of the following:
  - 1. Service cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
- B. Underground, soil, waste, and vent piping NPS 4 and smaller are to be the following:
  - 1. Service cast-iron soil piping; gaskets; and gasketed joints.
- C. Radon vent piping, aboveground and underground, are to be the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

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SECTION 221319 – SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Cleanouts.
  - 2. Miscellaneous sanitary drainage piping specialties.
- B. Related Requirements:
  - 1. Section 22 14 23 "Storm Drainage Piping Specialties" for roof drains.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheet where more than one products is to be described, clearly annotate which product(s) is to be supplied.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts (CO):
  - 1. Standard: ASME A112.36.2M.
  - 2. Size: Same as connected drainage piping
  - 3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
  - 4. Closure: Countersunk, brass plug.

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5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts (FCO):

1. Standard: ASME A112.36.2M for adjustable housing or threaded, adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Adjustable housing or threaded, adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Spigot or threaded.
7. Closure: Brass plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads or setscrews or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: Round.
11. Top-Loading Classification: Light Duty.
12. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts (WCO):

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure Plug:
  - a. Brass.
  - b. Countersunk head.
  - c. Drilled and threaded for cover attachment screw.
  - d. Size: Same as or not more than one size smaller than cleanout size.
5. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
  - a. NPS 2: 4-inch-minimum water seal.
  - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

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C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- E. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  2. Size: Same as floor drain inlet.
- F. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- G. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- H. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

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3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 PROTECTION

- A. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

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SECTION 221319.13 – SANITARY DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Floor drains.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is to be described, clearly annotate which product(s) is to be supplied.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains (FD):
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Josam Company.
    - c. MIFAB, Inc.
    - d. Sioux Chief Manufacturing Company, Inc.
    - e. WATTS; A Watts Water Technologies Company.
    - f. Wade; a subsidiary of McWane Inc.
    - g. Zurn Industries, LLC.

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2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Not required.
6. Anchor Flange: Not required.
7. Clamping Device: Not required.
8. Outlet: Bottom.
9. Sediment Bucket: Provide where scheduled on Drawings.
10. Top or Strainer Material: Nickel bronze.
11. Top of Body and Strainer Finish: Nickel bronze.
12. Top Shape: As scheduled on Drawings.
13. Dimensions of Top or Strainer: As scheduled on Drawings.
14. Top Loading Classification: Light Duty.
15. Funnel: As scheduled on Drawings.
16. Trap Material: Cast iron.
17. Trap Pattern: Standard P-trap.
18. Trap Features: Trap-seal primer valve drain connection.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  1. Position floor drains for easy access and maintenance.
  2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
  3. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

#### 3.2 CONNECTIONS

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 22 13 19 "Sanitary Waste Piping Specialties" for miscellaneous sanitary drainage piping specialties.
- C. Install piping adjacent to equipment to allow service and maintenance.

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3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION



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SECTION 221414 – STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
  - 2. Hubless, cast-iron soil pipe and fittings.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: On data submittal sheets where more than one product is to be described, clearly annotate which product(s) is to be supplied.
  - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
  - 2. Hubless, cast-iron soil pipe and fittings.
- C. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- D. Shop Drawings: For controlled flow roof drainage system. Include calculations, plans, sections, elevations, and details. Calculations shall be in accordance with ASPE and ANSI Standards.
- E. Provide piping layouts, including pipe size and insulation requirements, to General Contractor for inclusion in project coordination drawings.

1.3 QUALITY ASSURANCE

- A. Provide materials bearing label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are to be capable of withstanding the following minimum working pressure unless otherwise indicated:

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1. Storm Drainage Piping: 10-foot head of water.

## 2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

## 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. AB & I Foundry; a part of the McWane family of companies.
  2. Charlotte Pipe and Foundry Company.
  3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
  1. Marked with CISPI collective trademark and NSF certification mark.
  2. Standard: ASTM A74.
  3. Class: Service weight cast iron.
- C. Gaskets: ASTM C564, rubber.

## 2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. AB & I Foundry; a part of the McWane family of companies.
  2. Charlotte Pipe and Foundry Company.
  3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
  1. Marked with CISPI collective trademark and NSF certification mark.
  2. Standards: ASTM A888 and CISPI 301.
- C. Heavy-Duty, Hubless-Piping Couplings:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ANACO-Husky.
    - b. Charlotte Pipe and Foundry Company.

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- c. [Dallas Specialty & Mfg. Co.](#)
  - d. [Fernco Inc.](#)
  - e. [Ideal Tridon Group.](#)
  - f. [MIFAB, Inc.](#)
  - g. [Matco-Norca.](#)
  - h. [Mission Rubber Company, LLC; a division of MCP Industries.](#)
- 2. Standard: ASTM C1277 or ASTM C1540.
  - 3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
- B. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- C. Install piping in concealed locations.
  - 1. Piping installed in equipment rooms, service areas, and where indicated may be exposed.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
  - 1. Do not change direction of flow more than 90 degrees.
  - 2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

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- a. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install piping at the following minimum slopes unless otherwise indicated.
  - 1. Building Storm Drain: 1/4 inch per foot downward in direction of flow for piping NPS 3 and smaller; 1/8 inch per foot downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Storm Drainage Piping: 1/4 inch per foot downward in direction of flow.
- M. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Ch IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Plumbing Specialties:
  - 1. Install cleanouts in storm drainage gravity-flow piping in accessible locations.
    - a. Comply with requirements for cleanouts specified in Section 22 14 23 "Storm Drainage Piping Specialties."
  - 2. Install drains in storm drainage gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

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3.3 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 4. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for cast-iron storm drainage piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical cast-iron piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
  - 1. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 2. Comply with requirements for cleanouts and drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."

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3.6 IDENTIFICATION

- A. Identify exposed storm drainage piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Test Procedure:
    - a. Test storm drainage piping on completion of roughing-in.
    - b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - c. From 15 minutes before inspection starts until completion of inspection, water level must not drop.
    - d. Inspect joints for leaks.
  - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 5. Prepare reports for tests and required corrective action.

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3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.

3.9 PROTECTION

- A. Protect piping and drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day and when work stops.
- C. Repair damage to adjacent materials caused by storm drainage piping installation.

3.10 PIPING SCHEDULE

- A. Aboveground storm drainage piping is to be any of the following:
  - 1. Service weight, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
- B. Underground storm drainage piping shall be the following:
  - 1. Service weight, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

END OF SECTION

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SECTION 221423 – STORM DRAINAGE PIPING SPECIALITES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. General-purpose roof drains.
  - 2. Miscellaneous storm drainage piping specialties.
  - 3. Cleanouts.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Siphonic roof drains.
  - 2. Miscellaneous storm drainage piping specialties.
  - 3. Cleanouts.
- C. Provide specialties cut sheets to General Contractor for inclusion in project coordination drawings. Include all specialties dimensions, noting manufacturer’s clearance requirements, as well as location and sizes of all connections.

1.3 QUALITY ASSURANCE

- A. Provide drainage piping specialties are to bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 GENERAL-PURPOSE ROOF DRAINS

- A. Cast-Iron Roof Drains:
  - 1. Cast-Iron, Siphonic Roof Drains and Siphonic Overflow Roof Drain: (RD-1 and OD-1).
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:



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- 1) [Jay R. Smith Mfg Co; a division of Morris Group International.](#)
- 2) [Josam Company.](#)
- 3) [MIFAB, Inc.](#)
- 4) [Marathon Roofing Products.](#)
- 5) [Portals Plus; a division of Hart & Cooley, Inc.](#)
- 6) [Sioux Chief Manufacturing Company, Inc.](#)
- 7) [Wade; a subsidiary of McWane Inc.](#)
- 8) [Zurn Industries, LLC.](#)

- b. Standard: ASME A112.6.9.
- c. Body Material: Cast iron or ductile iron.
- d. Dimension of Body: 8- to 12-inch diameter.
- e. Dome Material: Aluminum or Cast iron.
- f. Combination flashing ring and gravel stop.
- g. Outlet: Bottom.
- h. Outlet Type: No-hub.
- i. Options:
  - 1) Extension collars.
  - 2) Sump Receiver plate.
  - 3) Water Dam: 2 inches high where scheduled on Drawings.

## 2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

### A. Metal Downspout Nozzles: (ODN).

1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. [Jay R. Smith Mfg Co; a division of Morris Group International.](#)
  - b. [Josam Company.](#)
  - c. [WATTS; A Watts Water Technologies Company.](#)
  - d. [Wade; a subsidiary of McWane Inc.](#)
  - e. [Zurn Industries, LLC.](#)
2. Description: Nozzle with wall flange and mounting holes to cover rough opening and serve as anchor.
3. Size: Same as connected storm drainage piping.
4. Material: Cast bronze or nickel bronze nozzle and flange.
5. Piping Connection Type: No-hub or slip on.
6. Finish: Nickel Bronze.
7. Opening Protection: Birdscreen.

## 2.3 CLEANOUTS

### A. Cast-Iron Cleanouts:

1. Cast-Iron Exposed Cleanouts: (CO).

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- a. Standard: ASME A112.36.2M.
  - b. Size: Same as connected branch.
  - c. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or no-hub, cast-iron pipe test tee as required to match connected piping.
  - d. Closure: Countersunk, brass plug.
  - e. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.
2. Cast-Iron Exposed Floor Cleanouts: (FCO).
  - a. Standard: ASME A112.36.2M.
  - b. Size: Same as connected branch.
  - c. Type: Adjustable housing or threaded, adjustable housing.
  - d. Body or Ferrule: Cast iron.
  - e. Outlet Connection: No-hub or hub with gasket.
  - f. Closure: Brass plug with straight threads and gasket.
  - g. Adjustable Housing Material: Cast iron with threads or setscrews or other device.
  - h. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
  - i. Frame and Cover Shape: Round.
  - j. Top Loading Classification: Light Duty.
  - k. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.
3. Cast-Iron Wall Cleanouts: (WCO).
  - a. Standard: ASME A112.36.2M. Include wall access.
  - b. Size: Same as connected drainage piping.
  - c. Body: Hub-and-spigot, cast-iron soil pipe T-branch or no-hub, cast-iron soil pipe test tee as required to match connected piping.
  - d. Closure Plug:
    - 1) Material: Brass.
    - 2) Head: Countersunk.
    - 3) Drilled and threaded for cover attachment screw.
    - 4) Size: Same as, or not more than, one size smaller than cleanout size.
  - e. Wall-Access Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install roof drains in accordance with roof membrane manufacturer's written installation instructions at low points of roof areas.
  1. Install flashing collar or flange of roof drain to maintain integrity of waterproof membranes where penetrated.
  2. Position roof drains for easy access and maintenance.

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- B. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.
- C. Install cleanouts in aboveground piping and building drain piping in accordance with the following instructions unless otherwise indicated:
  - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
  - 3. Locate cleanouts at minimum intervals of 50 ft. for piping NPS 4 and smaller and 100 ft. for larger piping.
  - 4. Locate cleanouts at base of each vertical storm piping conductor.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

### 3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 14 14 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

### 3.3 CLEANING

- A. Clean piping specialties during installation and remove dirt and debris as work progresses.

### 3.4 PROTECTION

- A. Protect piping specialties during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day and when work stops.

END OF SECTION

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SECTION 223300 – ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Commercial, light-duty, storage, electric, domestic-water heaters.
  - 2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is to be described, clearly annotate which product(s) is to be supplied.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Sustainable Design Submittals:
  - 1. Water Heaters: Product Data for water heater compliance with ASHRAE's "Advanced Energy Design Guides."
- D. Shop Drawings:
  - 1. Include diagrams for power, signal, and control wiring.
- E. Provide equipment cut sheets to General Contractor for inclusion in project coordination drawings. Include all equipment dimensions, noting manufacturer's clearance requirements, as well as location and sizes of all equipment connections.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Certificates: For each type of commercial, electric, domestic-water heater.

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- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
      - 1) Storage Tank: Three years.
      - 2) Controls and Other Components: Two years.
    - b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

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2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. A. O. Smith Corporation.
  - b. American Water Heaters.
  - c. Bradford White Corporation.
  - d. Heat Transfer Products, Inc.
  - e. Hubbell Water Heaters.
  - f. Lochinvar, LLC.
  - g. Rheem Manufacturing Company.
  - h. State Industries.
2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: UL 174.
4. Storage-Tank Construction: Steel, vertical arrangement.
  - a. Tappings: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig.
  - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. Factory-Installed, Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
  - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
  - d. Insulation: Comply with ASHRAE/IES 90.1.
  - e. Jacket: Steel with enameled finish or high-impact composite material.
  - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
  - g. Heating Elements: Electric, screw-in immersion type.
  - h. Temperature Control: Adjustable thermostat.
  - i. Safety Control: High-temperature-limit cutoff device or system.
  - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics: As scheduled on Drawings.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. A. O. Smith Corporation.
    - b. AMTROL, Inc.
    - c. Flexcon Industries.
    - d. Honeywell International Inc.
    - e. Pentair Aurora; Pentair Pump Group.
    - f. State Industries.
    - g. Taco Comfort Solutions.
  2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
  3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
  4. Construction:
    - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    - c. Air-Charging Valve: Factory installed.
  5. Capacity and Characteristics: As scheduled on Drawings.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE/IES 90.1.
- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
- F. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- G. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

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2.4 SOURCE QUALITY CONTROL

- A. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 03 30 00 "Cast-in-Place Concrete."
  - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
  - 2. Maintain manufacturer's recommended clearances.
  - 3. Arrange units so controls and devices that require servicing are accessible.
- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
  - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."
- E. Install thermometers on inlet and outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- F. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- G. Fill electric, domestic-water heaters with water.



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- H. Charge domestic-water expansion tanks with air to required system pressure.
- I. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Train University's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters. Training shall be a minimum of one hour(s).

END OF SECTION

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall-mounted water closets.
2. Flushometer valves.
3. Toilet seats.
4. Supports.

1.2 DEFINITIONS

- A. Standard-Efficiency Flush Volume: 1.6 gal. per flush.
- B. High-Efficiency Flush Volume: 1.28 gal. or less per flush.
- C. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
  2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings: Include diagrams for power and control wiring.
- D. Sustainable Design Submittals:
  1. Plumbing Fixtures: Provide manufacturer's cut sheets for plumbing fixtures indicating flush or flow rates.
- E. Provide fixture cut sheets to General Contractor for inclusion in project coordination drawings. Include all fixture dimensions, noting manufacturer's clearance requirements, as well as location and sizes of all fixture connections.

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1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Extra Stock Materials: Furnish extra materials to University that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
  - 1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
  - 2. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
  - 3. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
  - 4. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
  - 5. Comply with ASME A112.6.1M for water-closet supports.
  - 6. Comply with ICC A117.1 for ADA-compliant water closets.

2.2 WALL-MOUNTED WATER CLOSETS

- A. Water Closets - Wall Mounted, Top Spud: WC-1 and WC-2; WC-1 shall be accessible, WC-2 shall be standard.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Sloan Model ST-2459 or a comparable product by one of the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Zurn Industries, LLC.
  - 2. Source Limitations: Obtain water closets from single source from single manufacturer.

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3. Bowl:
  - a. Material: Vitreous china.
  - b. Type: Siphon jet.
  - c. Style: Flushometer valve.
  - d. Mounting Height: ADA compliant for WC-1; Standard for WC-2.
  - e. Rim Contour: Elongated.
  - f. Water Consumption: 1.28 gal. per flush.
  - g. Spud Size and Location: NPS 1-1/2; top.
  - h. Color: White.
4. Flushometer Valve: WC.
5. Toilet Seat: WC.
6. Support: Water-closet carrier.

## 2.3 FLUSHOMETER VALVES

### A. Flushometer Valves - Diaphragm, Solenoid Actuated: WC.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sloan Model III ESS, or a comparable, approved product.
2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Style: Exposed flushometer with recessed wall mounted sensor.
7. Exposed Flushometer-Valve Finish: Chrome-plated.
8. Panel Finish: Chrome-plated or stainless steel.
9. Actuator: Listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Hard-wired, control-voltage electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application. Provide manufacturer's low-voltage transformer(s) for sensor and solenoid operation.
11. Consumption: 1.28 gal. per flush.
12. Minimum Inlet: NPS 1.
13. Minimum Outlet: NPS 1-1/4.

## 2.4 TOILET SEATS

### A. Toilet Seats: WC.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Standard.
  - b. Bemis Manufacturing Company.

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- c. [Church Seats; Bemis Manufacturing Company.](#)
  - d. [Kohler Co.](#)
  - e. [TOTO USA, INC.](#)
  - f. [Zurn Industries, LLC.](#)
- 2. Source Limitations: Obtain toilet seat from single source from single manufacturer.
  - 3. Material: Plastic.
  - 4. Type: Commercial (Heavy duty).
  - 5. Shape: Elongated rim, open front.
  - 6. Hinge: Check.
  - 7. Hinge Material: Noncorroding metal.
  - 8. Seat Cover: Not required.
  - 9. Color: White.

## 2.5 SUPPORTS

### A. Water-Closet Carrier:

- 1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. [Jay R. Smith Mfg Co; a division of Morris Group International.](#)
  - b. [Josam Company.](#)
  - c. [MIFAB, Inc.](#)
  - d. [WATTS.](#)
  - e. [Zurn Industries, LLC.](#)
- 2. Source Limitations: Obtain water-closet carrier from single source from single manufacturer.
- 3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb.
2. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

B. Support Installation:

1. Use carrier supports with waste-fitting assembly and seal.
2. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
3. Measure support height installation from finished floor, not structural floor.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install actuators in locations easily reachable for people with disabilities.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

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3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- D. The electrical contractor (Division 26) shall furnish power wiring and connection to manufacturer's low-voltage transformer specified under this section. The plumbing contractor (Division 22) shall furnish low-voltage wiring and installation from low-voltage transformer to each flushometer.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 26 05 23 "Control-Voltage Electrical Power Cables."

3.6 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.7 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by University.

END OF SECTION

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Vitreous-china, wall-mounted lavatories.
  - 2. Automatically operated lavatory faucets.
  - 3. Supply fittings.
  - 4. Waste fittings.
  - 5. Lavatory supports.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Sustainable Design Submittals:
  - 1. Plumbing Fixtures: Provide manufacturer's cut sheets for plumbing fixtures indicating flush or flow rates.
- D. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.
- E. Provide fixture cut sheets to General Contractor for inclusion in project coordination drawings. Include all fixture dimensions, noting manufacturer’s clearance requirements, as well as location and sizes of all fixture connections.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Provide dimension drawings to GC for lavatories.



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1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Servicing and adjustments of automatic faucets.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory - Rectangular, Vitreous China, Wall Mounted, with Back, L-1 (ADA) and L-2:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Sloan Model SS-3103 or a comparable product by one of the following:
    - a. American Standard.
    - b. Kohler Co.
  - 2. Fixture:
    - a. Standard: ASME A112.19.2/CSA B45.1.
    - b. Type: For wall hanging.
    - c. Nominal Size: Rectangular, 20 by 18 inches.
    - d. Faucet-Hole Punching: One hole.
    - e. Faucet-Hole Location: Top.
    - f. Color: White.
    - g. Mounting Material: Chair carrier.
  - 3. Faucet: L.

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4. Support: Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.
5. Lavatory Mounting Height: Handicapped/elderly in accordance with ICC A117.1.

## 2.2 AUTOMATICALLY OPERATED LAVATORY FAUCETS

- A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Lavatory Faucets - Solar-Powered, Single Control Mixing Valve; Electronic Sensor Operated, with integral temperature control, L:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Sloan Model EAF-275-ISM or a comparable solar-powered product.
    - a. Advanced Modern Technologies Corporation-AMTC.
    - b. T&S Brass and Bronze Works, Inc.
  2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
  3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
  4. Body Type: Single hole.
  5. Body Material: Commercial, solid-brass.
  6. Finish: Polished chrome plate.
  7. Maximum Flow Rate: 0.35 gpm.
  8. Mounting Type: Deck, exposed.
  9. Spout: Rigid type.
  10. Spout Outlet: Aerator.
  11. Drain: Not part of faucet.
  12. Operation: Solar-powered, electric sensor actuator.
  13. Tempering Device: Spout mounted temperature mixer which can be converted to a fixed setting.

## 2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.

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F. Risers:

1. NPS 3/8.
2. Chrome-plated, soft-copper flexible tube or ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/4.
2. Material:
  - a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall or two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.

2.5 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. WATTS; A Watts Water Technologies Company.
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by University.

END OF SECTION

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SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Mop receptors.
  - 2. General purpose/utility sinks.
  - 3. Manually operated sink faucets.
  - 4. Supply fittings.
  - 5. Waste fittings.
  - 6. Sink supports.
  - 7. Grout.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
  - 2. Include rated capacities, operating characteristics and furnished specialties and accessories.
- C. Sustainable Design Submittals:
  - 1. Plumbing Fixtures: Provide manufacturer's cut sheets for plumbing fixtures indicating flush or flow rates.
- D. Provide fixture cut sheets to General Contractor for inclusion in project coordination drawings. Include all fixture dimensions, noting manufacturer's clearance requirements, as well as location and sizes of all fixture connections.

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1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Servicing and adjustments for automatic faucets.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 MOP RECEPTORS

- A. Mop Receptors - Terrazzo, Floor Mounted: MR-1.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Florestone Model 92 or a comparable product by one of the following:
    - a. Acorn Engineering Company; a Division of Morris Group International.
    - b. Fiat Products.
  - 2. Source Limitations: Obtain sinks from single source from single manufacturer.
  - 3. Fixture:

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- a. Material: Marble chips cast in portland cement to produce a compressive strength of not less than 3000 psi, seven days after casting.
  - b. Shape: Square.
  - c. Nominal Size: 32 by 32 inches.
  - d. Height: 12 inches with dropped front.
  - e. Tiling Flange: As required to suit installation location, refer to drawings.
  - f. Rim Guard: On all top surfaces.
  - g. Color: Not applicable.
  - h. Drain: Grid with NPS 3 outlet.
4. Mounting: On floor and flush to wall.
5. Faucet: MR-1.

## 2.2 GENERAL PURPOSE/UTILITY SINKS

### A. General Purpose/Utility Sinks - Stainless Steel, Counter-Mounted: S-1.

1. Basis-of-Design Product Subject to compliance with requirements, provide Elkay ELUHAD191655PD, or a comparable product by one of the following:
  - a. AERO Manufacturing Company.
  - b. Elkay.
  - c. Just.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
  - a. Standards:
    - 1) ASME A112.19.3/CSA B45.4.
    - 2) NSF 2.
  - b. Type: Stainless steel, self-rimming, sound-deadened unit.
  - c. Number of Compartments: One.
  - d. Overall Dimensions: 21-1/2 by 18-1/2 inches.
  - e. Material: 14-gauge, Type 304 stainless steel.
  - f. Compartment:
    - 1) Dimensions: 18 x 14 inches.
    - 2) Drain: Grid with NPS 1-1/2 tailpiece.
    - 3) Drain Location: Near back of compartment.
4. Faucet(s): S-1.
  - a. Number Required: One.
5. Supply Fittings:
  - a. Standard: ASME A112.18.1/CSA B125.1.

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- b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
    - 1) Operation: Loose key.
    - 2) Risers: NPS 1/2, chrome-plated, rigid-copper pipe.
- 6. Waste Fittings:
  - a. Standard: ASME A112.18.2/CSA B125.2.
  - b. Trap(s):
    - 1) Size: NPS 2.
    - 2) Material:
      - a) Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
  - c. Continuous Waste:
    - 1) Size: NPS 2.
    - 2) Material: Chrome-plated, 17-gauge brass tube.
- B. General Purpose/Utility Sinks - Stainless Steel, Counter-Mounted with Backsplash: S-2.
  - 1. Basis-of-Design Product Subject to compliance with requirements, provide Elkay ELUHAD191655PD, or a comparable product by one of the following:
    - a. AERO Manufacturing Company.
    - b. Just.
  - 2. Source Limitations: Obtain sinks from single source from single manufacturer.
  - 3. Fixture:
    - a. Standards:
      - 1) ASME A112.19.3/CSA B45.4.
      - 2) NSF 2.
    - b. Type: Stainless steel, self-rimming, sound-deadened unit with backsplash.
    - c. Number of Compartments: One.
    - d. Overall Dimensions: 21-1/2 by 18-1/2 inches.
    - e. Material: 16-gauge, Type 300 series stainless steel.
    - f. Compartment:
      - 1) Dimensions: 18 x 14 inches.
      - 2) Drain: Grid with NPS 1-1/2 tailpiece.
      - 3) Drain Location: Near back of compartment.
  - 4. Faucet(s): S-1A.



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- a. Number Required: One.
- 5. Supply Fittings:
  - a. Standard: ASME A112.18.1/CSA B125.1.
  - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
    - 1) Operation: Loose key.
    - 2) Risers: NPS 1/2, chrome-plated, rigid-copper pipe.
- 6. Waste Fittings:
  - a. Standard: ASME A112.18.2/CSA B125.2.
  - b. Trap(s):
    - 1) Size: NPS 2.
    - 2) Material:
      - a) Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
  - c. Continuous Waste:
    - 1) Size: NPS 2.
    - 2) Material: Chrome-plated, 17-gauge brass tube.

## 2.3 MANUALLY OPERATED SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Sink Faucets - Manual Type: Two-handle mixing, S-1.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Model Z842H1-XL (S-1A) and T&S Model MPZ-8WLN-06 (S-1B Pre-Rinse), or a comparable product by one of the following:
    - a. American Standard.
    - b. Chicago Faucets; Geberit Group.
    - c. Elkay.
    - d. Kohler Co.
    - e. Krowne.
  - 2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
  - 3. Standard: ASME A112.18.1/CSA B125.1.

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4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Widespread.
6. Body Material: Commercial, solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 1.5 gpm.
9. Mounting Type: Back/wall, exposed.
10. Valve Handle(s): Lever.
11. Spout Type: Swing. Length of spout shall be center of fixture.
12. Spout Outlet: Aerator.
13. Pre-Rinse Unit:
  - a. Style: Stainless steel flexible hose.
  - b. Hose: 24-inch.
  - c. Spray: Self-closing handheld valve.
  - d. Wall bracket.

C. Commercial Service Sink Faucets - Manual Type: MR-1.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Model Z843M1 or a comparable product by one of the following:
  - a. Acorn Engineering Company; a Division of Morris Group International.
  - b. American Standard.
  - c. Chicago Faucets; Geberit Group.
  - d. Fiat Products.
  - e. Kohler Co.
  - f. T&S Brass and Bronze Works, Inc.
2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
3. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch hose thread end, integral vacuum breaker, inlets 8 inches o.c., and two-handle mixing.
4. Faucet:
  - a. Standards:
    - 1) ASME A112.18.1/CSA B125.1.
    - 2) NSF 61 and NSF 372.
    - 3) ICC A117.1.
    - 4) ASSE 1001 (VB).
  - b. Body Material: Commercial, solid brass.
  - c. Finish: Polished chrome plated brass.
  - d. Handles: Lever.
  - e. Cartridges: One-fourth turn compression, ceramic.
  - f. Brace: Adjustable top brace.

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D. FOOT OPERATED SINK FAUCET: S-2, S-3

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay LK398C, or comparable product by one of the following:
  - a. American Standard
  - b. Bradley Corporation
  - c. Delta Faucet Company
  - d. Elkay
  - e. Kohler Co
2. Configuration: Hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
3. Body Type: Single hole.
4. Body Material: Solid brass.
5. Finish: Polished chrome plate.
6. Maximum Flow Rate: 2.2 gpm.
7. Control:
  - a. Foot pedal.
8. Mounting Type: Deck, exposed.
9. Spout Type: Swivel.

2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
  1. NPS 3/8.
  2. Chrome-plated, soft-copper flexible tube or ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.

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- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
  - 1. Size: NPS 1-1/2.
  - 2. Material:
    - a. Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.

## 2.6 PLASTER TRAPS

- A. Plaster Traps: S-1.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Gleco Trap model GT64 or a comparable product.
  - 2. Description: Manufactured assembly included screw top, 84 ounce capacity translucent plastic bottle with O-ring seal; PVC piping components; and integral PVC drain line and valve.

## 2.7 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install sinks level and plumb in accordance with rough-in drawings.
- B. Install wall-mounted sinks at accessible mounting height in accordance with ICC A117.1.

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- C. Set floor-mounted sinks in leveling bed of cement grout.
- D. Install water-supply piping with stop on each supply to each sink faucet.
  - 1. Exception: Use ball valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."
  - 2. Install stops in locations where they can be easily reached for operation.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- F. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- G. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

### 3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by University.

END OF SECTION

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SECTION 224223 - COMMERCIAL SHOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Individual showers.
- 2. Shower faucets.
- 3. Grout.

B. Related Requirements:

- 1. Section 221319.13 "Sanitary Drains" for shower drains.
- 2. Section 224500 "Emergency Plumbing Fixtures" for emergency showers.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of the Construction Contract Clauses, Section 007213 "General Conditions" and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for showers.
  - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of the Construction Contract Clauses, Section 007213 "General Conditions" and the individual sections specifying the work.
- B. Maintenance Data: For shower faucets to include in maintenance manuals.

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PART 2 - PRODUCTS

2.1 INDIVIDUAL SHOWERS

A. Individual FRP Showers, Accessible for Side Transfer (SH-1):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Oasis Model SHMD-3636, or a comparable approved product by one of the following:
  - a. Clarion Bathware.
  - b. Florestone Products Co., Inc.
  - c. LASCO Bathware.
  - d. Sterling.
  - e. Swan Corporation.
2. General: FRP, accessible, shower enclosure with faucet and receptor and appurtenances.
3. Standard: ANSI Z124.1.2.
4. Type: One-piece unit without top.
5. Style: Standard.
6. Faucet: SH-2.
7. Nominal Size and Shape: 36 by 36 inches.
8. Color: White.
9. Bathing Surface: Slip resistant according to ASTM F 462.
10. Outlet: Drain with NPS 2 outlet.
11. Shower Rod: Required.
12. Integral Shelves: Required.

2.2 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets, Accessible (SH-1):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries Temp-Gard III Model Z7300-SS-HW-MT or a comparable product by one of the following:
  - a. Kohler Co.
  - b. Leonard Valve Company.
  - c. Moen Incorporated.
  - d. Sloan Valve Company.
2. Description: Single-handle, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and removable hand shower with hose and slide bar.
3. Faucet:
  - a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
  - b. Body Material: Solid brass.
  - c. Finish: Polished chrome plate.

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- d. EPA WaterSense: Required.
  - e. Mounting: Concealed.
  - f. Operation: Single-handle, twist or rotate control.
  - g. Antiscald Device: Integral with mixing valve.
  - h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
- 4. Supply Connections: NPS 1/2.
  - 5. Shower Head:
    - a. Standard: ASME A112.18.1/CSA B125.1.
    - b. Type: Fixed flow, hand held.
    - c. Spray Pattern: Fixed.
    - d. Integral Volume Control: 1.5 gpm flow restrictor.
    - e. Hose: 59-inch length.
    - f. Slide Bar: 25-inch, metal.
    - g. Vacuum Breaker: Required.

## 2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before shower installation.
- B. Examine walls and floors for suitable conditions where showers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Assemble shower components according to manufacturers' written instructions.
- B. Install showers level and plumb according to roughing-in drawings.
- C. Install water-supply piping with stop on each supply to each shower faucet.



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1. Exception: Use ball valves if supply stops are not specified with shower. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."
  2. Install stops in locations where they can be easily reached for operation.
- D. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- E. Set shower receptors in leveling bed of cement grout.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent and Radon Piping."

3.4 ADJUSTING

- A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of showers, inspect and repair damaged finishes.
- B. Clean showers, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.
- D. Do not allow use of showers for temporary facilities unless approved in writing by Owner.

END OF SECTION

## SECTION 224500 - EMERGENCY PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Combination units.
  - 2. Deck-mounted eyewash units.
  - 3. Water-tempering equipment.

#### 1.3 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- C. Tepid: Moderately warm.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
- C. Field quality-control test reports.

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1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- C. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.
- D. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

- A. Accessible, Plumbed Emergency Shower with Eye/Face Wash Combination Units (EM-1):
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Model GBF1909SSH, or a comparable product by one of the following:
    - a. Acorn Safety.
    - b. Bradley Corporation.
    - c. Encon Safety Products.
    - d. Haws Corporation.
    - e. WaterSaver Faucet Co.
  - 2. Piping:
    - a. Material: Chrome-plated brass or stainless steel.
    - b. Unit Supply: NPS 1-1/4 minimum.
    - c. Unit Drain: Outlet at back or side near bottom.
  - 3. Shower:
    - a. Capacity: Not less than 20 gpm for at least 15 minutes.
    - b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
    - c. Control-Valve Actuator: Pull rod.

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- d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel.
  - e. Mounting: Pedestal.
4. Eye/Face Wash Unit:
- a. Capacity: Not less than 3 gpm for at least 15 minutes.
  - b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
  - c. Control-Valve Actuator: Paddle.
  - d. Spray-Head Assembly: Two or four receptor-mounted spray heads.
  - e. Receptor: Chrome-plated brass or stainless-steel bowl.
  - f. Mounting: Attached to shower pedestal.

## 2.2 EYEWASH UNITS

A. Eyewash Units - Deck or Wall Mounted, Swivel Type, Plumbed: .

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Bradley Corporation
  - b. Guardian Equipment Co
  - c. Speakman Company
- 2. Source Limitations: Obtain eyewash units, deck mounted, swivel type, plumbed, from single manufacturer.
- 3. Capacity: Not less than 0.4 gpm for at least 15 minutes.
- 4. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
- 5. Control-Valve Actuator: Movement of spray-head assembly to position over sink.
- 6. Spray-Head Assembly: Two spray heads with offset piping.
- 7. Mounting: Deck mounted next to sink.

## 2.3 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment (EMV):

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product scheduled on Drawings or a comparable product by one of the following:
  - a. Encon Safety Products.
  - b. Haws Corporation.
  - c. Leonard Valve Company.
  - d. Powers.
- 2. Description: Factory-fabricated equipment with thermostatic mixing valve.

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- a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
- b. Supply Connections: For hot and cold water.

2.4 SOURCE QUALITY CONTROL

- A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures. Use ball valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping."
  - 1. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221116 "Domestic Water Piping."
- F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- G. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."

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- H. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 CONNECTIONS

- A. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 221116 "Domestic Water Piping."
- B. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent and Radon Piping."
- C. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste system. Comply with requirements for indirect waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

### 3.4 IDENTIFICATION

- A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.5 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

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- C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION

SECTION 224716 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Pressure water coolers.
  - 2. Supports.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of pressure water cooler and bottle filling station. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Sustainable Design Submittals:
  - 1. Plumbing Fixtures: Provide manufacturer's cut sheets for plumbing fixtures indicating flush or flow rates.
- D. Shop Drawings:
  - 1. Include diagrams for power wiring.
- E. Provide fixture cut sheets to General Contractor for inclusion in project coordination drawings. Include all fixture dimensions, noting manufacturer's clearance requirements, as well as location and sizes of all fixture connections.



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1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For pressure water coolers and bottle filling stations to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than one of each.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
  - 1. Pressure water coolers and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
  - 2. Comply with ASHRAE 34 for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
  - 3. Comply with UL 399.
  - 4. Comply with ASME A112.19.3/CSA B45.4.
  - 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 6. Comply with NSF 42 and NSF 53 for water filters for water coolers and bottle filling stations.
  - 7. Comply with ICC A117.1 for accessible water coolers and bottle filling stations.

2.2 PRESSURE WATER COOLERS

- A. Pressure Water Coolers with Integral Bottle Filler - Inwall Frame/Plate, Wall-Mounted, Stainless Steel: EWC-1.

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1. Basis-of-Design Product: Subject to compliance with requirements, provide Filtrine Model B103-107-16-MOD-HL-TM-HF or comparable product by one of the following:
  - a. Elkay.
  - b. Halsey Taylor.
  - c. Oasis International.
2. Source Limitations: Obtain inwall frame/plate, wall-mounted, stainless steel, pressure water coolers from single source from single manufacturer.
3. Description: Bi-level, 16-in diameter circular fountains with integral bottle filling station.
4. Type: Vandal resistant.
5. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
6. Control: Sensor.
7. Bottle Filler: Sensor activation, with 20-second automatic shutoff timer: Fill rate 0.5 to 1.5 gpm.
8. Drain: Grid with NPS 1-1/4 tailpiece.
9. Supply: NPS 3/8 with shutoff valve.
10. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
11. Filter: One or more water filters with capacity sized for unit peak flow rate.
12. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
13. Ventilation Grille: Stainless steel, located below water cooler.
14. Support: Water-cooler carrier.
15. Water-Cooler Mounting Height: High/low - standard/accessible in accordance with ICC A117.1.
16. Capacities and Characteristics:
  - a. Cooled Water: 6 gph.
  - b. Ambient Air Temperature: 90 deg F.
  - c. Inlet-Water Temperature: 80 deg F.
  - d. Cooled-Water Temperature: 50 deg F.
  - e. Electrical Characteristics:
    - 1) Volts: 120-V ac.
    - 2) Phase: Single.

## 2.3 SUPPORTS

### A. Water-Cooler Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.

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- d. [Wade Drains.](#)
- e. [Zurn Industries, LLC.](#)

2. Standard: ASME A112.6.1M.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping"
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

#### 3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

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- C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.6 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by University.

END OF SECTION

## SECTION 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

#### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

#### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

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2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
  - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

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2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 230517 – SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves without waterstop.
2. Sleeve-seal systems.
3. Grout.
4. Silicone sealants.

1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATERSTOP

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
- C. Steel Sheet Sleeves: ASTM A653/A653M, 0.0239-inch minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.



## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Designed to form a hydrostatic seal of 20 psig.
  - 2. Sealing Elements: EPDM-rubber, high-temperature-silicone, or nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
  - 3. Pressure Plates: Carbon steel, composite plastic, or stainless steel.
  - 4. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating or stainless steel of length required to secure pressure plates to sealing elements.

## 2.3 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.

# PART 3 - EXECUTION

## 3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.

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- a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
- 2. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

### 3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeves.

### 3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

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2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

### 3.5 SLEEVE SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:
  - a. Sleeves with waterstops.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade:
  - a. Sleeves with waterstops.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
  - a. Sleeves with waterstops.
4. Interior Walls and Partitions:
  - a. Sleeves without waterstops.

END OF SECTION

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SECTION 230518 – ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Escutcheons.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- B. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.
- D. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

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- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons.

END OF SECTION

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SECTION 230519 – METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Liquid-in-glass thermometers.
- 2. Thermowells.
- 3. Dial-type pressure gages.
- 4. Gage attachments.
- 5. Test plugs.

- B. Related Requirements:

- 1. Section 231123 "Facility Natural-Gas Piping" for gas meters.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 LIQUID-IN-GLASS THERMOMETERS

#### A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.
2. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
3. Case Form: Adjustable angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
6. Window: Glass.
7. Stem: Aluminum and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
8. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

### 2.2 THERMOWELLS

#### A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

#### B. Heat-Transfer Medium: Mixture of graphite and glycerin.

### 2.3 DIAL-TYPE PRESSURE GAGES

#### A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

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4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Metal.
10. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

## 2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## 2.5 TEST PLUGS

- A. Description: Test-station fitting made for insertion in piping tee fitting.
- B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- C. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- E. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.



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- G. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic boiler.
  - 3. Inlet and outlet of each chiller.
  - 4. Inlet and outlet of each hydronic coil in air-handling units.
- J. Install pressure gages in the following locations:
  - 1. Discharge of each pressure-reducing valve.
  - 2. Inlet and outlet of each chiller chilled-water connection.
  - 3. Suction and discharge of each pump.

### 3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.

### 3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

**END OF SECTION**

SECTION 230523.12 – BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Steel ball valves.
3. Iron ball valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.
- C. SWP: Steam working pressure.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of valve. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, and weld ends.
  3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for cast copper solder-joint connections.
5. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
6. ASME B16.34 for flanged and threaded end connections.
7. ASME B31.9 for building services piping valves.

- B. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

- C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- D. Valve Sizes: Same as upstream piping unless otherwise indicated.

E. Valve Actuator Types:

1. Hand Lever: For quarter-turn valves smaller than NPS 4.

F. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.
2. Extended operating handles with nonthermal-conductive covering material, and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two Piece with Full Port and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Standard: MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.

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6. Ends: Threaded or soldered.
7. Seats: PTFE.
8. Stem: Bronze.
9. Ball: Chrome-plated brass.
10. Port: Full.

B. Bronze Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:

1. Standard: MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Threaded or soldered.
7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.

2.4 STEEL BALL VALVES

A. Steel Ball Valves with Full Port and Stainless Steel Trim, Class 150:

1. Standard: MSS SP-72.
2. CWP Rating: 285 psig.
3. Body Design: Split body.
4. Body Material: Carbon steel, ASTM A216/A216M, Type WCB.
5. Ends: Flanged.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.
9. Port: Full.

2.5 IRON BALL VALVES

A. Iron Ball Valves, Class 125:

1. Standard: MSS SP-72.
2. CWP Rating: 200 psig.
3. Body Design: Split body.
4. Body Material: ASTM A126, gray iron.
5. Ends: Flanged.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel.
9. Port: Full.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

#### 3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

#### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are unavailable, provide the same types of valves with higher SWP classes or CWP ratings.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  - 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

### 3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze ball valves.
  - 1. Valves may be provided with solder-joint ends instead of threaded ends.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Iron ball valves, Class 125.
    - a. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  - 2. Steel ball valves, Class 150.

### 3.6 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze ball valves.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Iron ball valves, Class 125.
    - a. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  - 2. Steel ball valves, Class 150.

END OF SECTION

SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Metal framing systems.
- 4. Thermal-hanger shield inserts.
- 5. Fastener systems.
- 6. Equipment supports.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- 2. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
- 3. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Pipe stands.
  - 4. Equipment supports.

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1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.



## 2.4 METAL FRAMING SYSTEMS

### A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with intumed lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Pregalvanized G90.

## 2.5 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield.

## 2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Indoor Applications: Zinc-coated steel.
  - 2. Outdoor Applications: Stainless steel.

## 2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

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2.8 MATERIALS

- A. Carbon Steel: ASTM A1011/A1011M.
- B. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- C. Stainless Steel: ASTM A240/A240M.
- D. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

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- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
- 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in [Section 099113 "Exterior Painting"] [Section 099123 "Interior Painting"] [and] [Section 099600 "High-Performance Coatings"] <Insert painting Sections> for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.

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4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 1-1/2.
  6. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  7. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  9. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  8. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  9. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

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10. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 230548.13 – VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Elastomeric isolation pads.
  - 2. Elastomeric isolation mounts.
  - 3. Restrained elastomeric isolation mounts.
  - 4. Housed-restrained-spring isolators.
  - 5. Elastomeric hangers.
  - 6. Spring hangers.
  - 7. Vibration isolation equipment bases.
  - 8. Restrained isolation roof-curb rails.

1.3 DEFINITIONS

- A. IBC: International Building Code.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Include load rating for each wind-force-restraint fitting and assembly.
  - 3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device component.
  - 4. Annotate to indicate application of each product submitted and compliance with requirements.
  - 5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- C. Shop Drawings:
  - 1. Detail fabrication and assembly of equipment bases.



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2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints.
- C. Qualification Data: For testing agency.
- D. Welding certificates.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7 and be acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire/Smoke Resistance: All components that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.
- B. Component Supports:
  1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.

2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:

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1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Minimum Deflection: 0.1 inches.
4. Pad Material: Oil- and water-resistant rubber.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.
  - a. Infused nonwoven cotton or synthetic fibers.

## 2.3 ELASTOMERIC ISOLATION MOUNTS

### A. Elastomeric Isolation Mounts:

1. Mounting Plates:
  - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
  - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Minimum Deflection: 0.35 inches.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

### A. Restrained Elastomeric Isolation Mounts:

1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  - a. Housing: Cast-ductile iron or welded steel.
  - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
2. Minimum Deflection: 0.20 inches.

## 2.5 HOUSED-RESTRAINED-SPRING ISOLATORS

### A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

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- a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psi.
  - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Minimum deflection as indicated on Drawings.

## 2.6 ELASTOMERIC HANGERS

### A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.
3. Minimum deflection as indicated on Drawings.

## 2.7 SPRING HANGERS

### A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Minimum deflection as indicated on Drawings.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.8 VIBRATION ISOLATION EQUIPMENT BASES

- A. Steel Rails: Factory-fabricated, welded, structural-steel rails.
  - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
    - a. Include supports for suction and discharge elbows for pumps.
  - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
  - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
  - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
  - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
  - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
  - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
  - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

## 2.9 RESTRAINED ISOLATION ROOF-CURB RAILS

- A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.
- B. Upper Frame: Shall provide continuous and captive support for equipment.

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- C. Lower Support Assembly: Shall be formed sheet metal section containing adjustable and removable steel springs that support upper frame. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials and shall be insulated with a minimum of 2 inches of rigid glass-fiber insulation on inside of assembly.
  - 1. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with integrity of roof.
  - 2. Minimum deflection as indicated on Drawings.
- D. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static and wind force loads within specified loading limits.

#### 3.3 INSTALLATION OF VIBRATION CONTROL DEVICES

- A. Provide vibration control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- C. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

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- D. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

3.4 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

- A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate dimensions of equipment bases with requirements of isolated equipment specified in this and other Sections. Where dimensions of base are indicated on Drawings, they may require adjustment to accommodate isolated equipment.

3.5 ADJUSTING

- A. Adjust isolators after system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Measure isolator restraint clearance.
  - 2. Measure isolator deflection.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

END OF SECTION

## SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

#### 1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Samples: For color, letter style, and graphic representation required for each identification material and device.
- D. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- E. Valve-numbering scheme.
- F. Valve Schedules: Provide for each piping system. Include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

##### A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

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4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  6. Fasteners: Stainless steel rivets or self-tapping screws.
  7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

## 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-taping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.



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- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
  - 1. Pipe size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
  - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

## 2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:
  - 1. Duct size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution ducts. Arrows may be either integral with label or may be applied separately.

## 2.5 STENCILS

- A. Stencils for Piping:
  - 1. Lettering Size: Size letters in accordance with ASME A13.1 for piping.
  - 2. Stencil Material: Aluminum, brass, or fiberboard.
  - 3. Stencil Paint: Exterior, gloss, acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

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4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
5. Letter and Background Color: As indicated for specific application under Part 3.

B. Stencils for Ducts:

1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances of up to 15 ft. and proportionately larger lettering for greater viewing distances.
2. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
4. Letter and Background Color: Color as indicated for specific application under Part 3.

C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
4. Letter and Background Color: As indicated for specific application under Part 3.

## 2.6 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.04-inch; stainless steel, 0.024-inch; aluminum, 0.031-inch; or anodized aluminum, 0.031-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire, link chain, or S-hook.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

## 2.7 WARNING TAGS

A. Description: Preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

#### 3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

#### 3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of mechanical equipment.
- B. Sign and Label Colors:
  - 1. White letters on an ANSI Z535.1 safety-blue background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

#### 3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

#### 3.5 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

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- B. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within 3 ft. of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 3. Within 3 ft. of equipment items and other points of origination and termination.
  - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.
- D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- E. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- F. Pipe-Label Color Schedule:
  - 1. Chilled-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  - 2. Heating Water Piping: White letters on an ANSI Z535.1 safety-green background.
  - 3. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.

### 3.6 INSTALLATION OF DUCT LABELS

- A. Install plastic-laminated or self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.
  - 1. Provide labels in the following color codes:
    - a. For air supply ducts: White letters on blue background.
    - b. For air return ducts: White letters on blue background.
    - c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on blue background.
- B. Stenciled Duct-Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
  - 1. For all air ducts: Black letters on white background.
- C. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of 20 ft. where exposed or are concealed by removable ceiling system.

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D. Stenciled Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Black letters on White background.

3.7 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.

1. Valve-Tag Size and Shape:

- a. Chilled Water: 1-1/2 inches, round.
- b. Refrigerant: 1-1/2 inches, round.
- c. Hot Water: 1-1/2 inches, round.
- d. Gas: 1-1/2 inches, round.

2. Valve-Tag Colors:

- a. For each piping system, use the same lettering and background coloring system on valve tags as used for the Pipe Label Schedule text and background.

3.8 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings and as scheduled.

END OF SECTION

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SECTION 230593 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
  - a. Constant-volume air systems.
  - b. Variable-air-volume systems.
2. Testing, Adjusting, and Balancing of Hydronic Piping Systems:
  - a. Variable-flow hydronic systems.
  - b. Primary-secondary hydronic systems.
3. Testing, adjusting, and balancing of equipment.
4. Sound tests.

B. Related Requirements:

1. Section 220593 “Testing, Adjusting and Balancing for Plumbing”

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.
- G. UFAD: Underfloor air distribution.

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1.4 PREINSTALLATION MEETINGS

- A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
  - 1. Minimum Agenda Items:
    - a. The Contract Documents examination report.
    - b. The TAB plan.
    - c. Needs for coordination and cooperation of trades and subcontractors.
    - d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- C. Contract Documents Examination Report: Within 90 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- D. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- E. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- F. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- G. Certified TAB reports.
- H. Sample report forms.
- I. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

1.6 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by NEBB, TABB, or AABC:

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1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB, TABB, or AABC.
  2. TAB Technician: Employee of the TAB specialist and certified by NEBB, TABB, or AABC.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- D. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan and pump curves.
  1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.



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- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.
- L. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work and provide a system-readiness report. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.

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- e. Fans are operating, free of vibration, and rotating in correct direction.
- f. Variable-frequency controllers' startup is complete and safeties are verified.
- g. Automatic temperature-control systems are operational.
- h. Ceilings are installed.
- i. Windows and doors are installed.
- j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

- a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
- b. Piping is complete with terminals installed.
- c. Water treatment is complete.
- d. Systems are flushed, filled, and air purged.
- e. Strainers are pulled and cleaned.
- f. Control valves are functioning in accordance with the sequence of operation.
- g. Shutoff and balance valves have been verified to be 100 percent open.
- h. Pumps are started and proper rotation is verified.
- i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
- j. Variable-frequency controllers' startup is complete and safeties are verified.
- k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
  - 3. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
  - 4. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

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3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
1. Motors.
  2. Pumps.
  3. Fans and ventilators.
  4. Terminal units.
  5. Boilers.
  6. Unit heaters.
  7. Condensing units.
  8. Water chillers.
  9. Energy-recovery units.
  10. Air-handling units.
  11. Rooftop air-conditioning units.
  12. Dedicated outdoor-air units.
  13. Split-system air conditioners.
  14. Valance heating and cooling units.
  15. Coils.
  16. Radiators.
  17. Convectors.
  18. Finned-tube radiation heaters.
  19. Radiant-heating.
  20. Humidifiers.
  21. Dehumidification units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.

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- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Set outside-air and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  - 2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  - 3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  - 1. Measure airflow of submain and branch ducts.
  - 2. Adjust submain and branch duct volume dampers for specified airflow.
  - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
  - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  - 2. Measure inlets and outlets airflow.
  - 3. Adjust each inlet and outlet for specified airflow.
  - 4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
  - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
  - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
  - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
  - d. Adjust controls so that terminal is calling for minimum airflow.
  - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
  - f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
  - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
  - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.

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- c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
  - d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
- 6. Measure fan static pressures as follows:
  - a. Measure static pressure directly at the fan outlet or through the flexible connection.
  - b. Measure static pressure directly at the fan inlet or through the flexible connection.
  - c. Measure static pressure across each component that makes up the air-handling system.
  - d. Report any artificial loading of filters at the time static pressures are measured.
- 7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
  - a. Balance the return-air ducts and inlets.
  - b. Verify that terminal units are meeting design airflow under system maximum flow.
- 8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
- 9. Verify final system conditions as follows:
  - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - b. Re-measure and confirm that total airflow is within design.
  - c. Re-measure final fan operating data, speed, volts, amps, and static profile.
  - d. Mark final settings.
  - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
  - f. Verify tracking between supply and return fans.

### 3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and equipment flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
  - 1. Check expansion tank for proper setting.
  - 2. Check highest vent for adequate pressure.
  - 3. Check flow-control valves for proper position.
  - 4. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
  - 5. Verify that motor controllers are equipped with properly sized thermal protection.

6. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
  1. Check settings and operation of each safety valve. Record settings.

### 3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.
- B. Adjust the variable-flow hydronic system as follows:
  1. Verify that the pressure-differential sensor(s) is located as indicated.
  2. Determine whether there is diversity in the system.
- C. For systems with flow diversity:
  1. Determine diversity factor.
  2. Simulate system diversity by closing required number of control valves, as approved by Architect.
  3. Adjust pumps to deliver total design flow.
    - a. Measure total water flow.
      - 1) Position valves for full flow through coils.
      - 2) Measure flow.
      - 3) Determine flow by pump TDH.
    - b. Measure pump TDH as follows:
      - 1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      - 2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      - 3) Convert pressure to head and correct for differences in gauge heights.
      - 4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
      - 5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

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- c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
4. Adjust flow-measuring devices installed in mains and branches to design water flows.
  - a. Measure flow in main and branch pipes.
  - b. Adjust main and branch balance valves for design flow.
  - c. Re-measure each main and branch after all have been adjusted.
5. Adjust flow-measuring devices installed at terminals for each space to design water flows.
  - a. Measure flow at terminals.
  - b. Adjust each terminal to design flow.
  - c. Re-measure each terminal after it is adjusted.
  - d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
  - e. Perform temperature tests after flows have been balanced.
6. For systems with pressure-independent valves at terminals:
  - a. Measure differential pressure, and verify that it is within manufacturer's specified range.
  - b. Perform temperature tests after flows have been verified.
7. For systems without pressure-independent valves or flow-measuring devices at terminals:
  - a. Measure and balance coils by either coil pressure drop or temperature method.
  - b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system pressure-differential set point(s).
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:
  - a. Re-measure and confirm that total water flow is within design.
  - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
  - c. Mark final settings.

### 3.10 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:



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1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

### 3.11 PROCEDURES FOR WATER CHILLERS

- A. Air-Cooled Chillers: Balance water flow through each evaporator to within specified tolerances of indicated flow, with all pumps operating. With only one chiller operating in a multiple-chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
3. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
4. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
5. Capacity: Calculate in tons of cooling.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
7. Verify condenser-fan rotation and record fan and motor data, including number of fans and entering- and leaving-air temperatures.

### 3.12 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.
- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of compressor(s), fan(s), and motors.

### 3.13 PROCEDURES FOR BOILERS

- A. Hydronic Boilers:
1. Measure and record entering- and leaving-water temperatures.
  2. Measure and record water flow.
  3. Measure and record pressure drop.
  4. Record relief valve(s) pressure setting.

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5. Capacity: Calculate in Btu/h of heating output.
6. Fuel Consumption: If boiler fuel supply is equipped with flow meter, measure and record consumption.
7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data.

3.14 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each hydronic coil:
1. Entering- and leaving-water temperature.
  2. Water flow rate.
  3. Water pressure drop.
  4. Dry-bulb temperature of entering and leaving air.
  5. Wet-bulb temperature of entering and leaving air for cooling coils.
  6. Airflow.
  7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
1. Nameplate data.
  2. Airflow.
  3. Entering- and leaving-air temperature at full load.
  4. Air pressure drop.
  5. Voltage and amperage input of each phase at full load.
  6. Calculated kilowatt at full load.
  7. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
1. Dry-bulb temperature of entering and leaving air.
  2. Airflow.
  3. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:
1. Dry-bulb temperature of entering and leaving air.
  2. Wet-bulb temperature of entering and leaving air.
  3. Airflow.
  4. Air pressure drop.
  5. Entering and leaving refrigerant pressure and temperatures.

3.15 SOUND TESTS

- A. After systems are balanced and Substantial Completion, measure and record sound levels at 25 locations as designated by the Architect.
- B. Instrumentation:

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1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level ( $L_{eq}$ ).
3. The sound-testing meter must be capable of using one-third octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:

1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
2. Equipment should be operating at design values.
3. Calibrate the sound-testing meter prior to taking measurements.
4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight unweighted octave bands as designated by the Architect with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight unweighted octave bands as designated by the Architect with the equipment operating.
7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:
  - a. Location.
  - b. System tested.
  - c. dBA reading.
  - d. Sound pressure level in each octave band with equipment on and off.
2. Plot sound pressure levels on Noise Criteria (NC) and Room Criteria (RC) worksheet with equipment on and off.

3.16 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify HVAC control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.

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8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
  9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.17 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent or minus 5 percent. If design value is less than 100 cfm, within 10 cfm.
  2. Air Outlets and Inlets: Plus 10 percent or minus 5 percent. If design value is less than 100 cfm, within 10 cfm.
  3. Heating-Water Flow Rate: Plus 10 percent or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
  4. Chilled-Water Flow Rate: Plus 10 percent or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.18 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.19 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
  3. Certify validity and accuracy of field data.

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B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report.  
Number each page in the report.
11. Summary of contents, including the following:
  - a. Indicated versus final performance.
  - b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms, including the following:
  - a. Settings for outdoor-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Heating coil, dry-bulb conditions.
  - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
  - f. Variable-frequency controller settings for variable-air-volume systems.
  - g. Settings for pressure controller(s).
  - h. Other system operating conditions that affect performance.
16. Test conditions for pump performance forms, including the following:
  - a. Variable-frequency controller settings for variable-flow hydronic systems.
  - b. Settings for pressure controller(s).
  - c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

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1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units, include the following:

1. Unit Data:
  - a. Unit identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and unit size.
  - e. Manufacturer's serial number.
  - f. Unit arrangement and class.
  - g. Discharge arrangement.
  - h. Sheave make, size in inches, and bore.
  - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - j. Number, make, and size of belts.
  - k. Number, type, and size of filters.
2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and speed.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
  - a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan speed.
  - d. Inlet and discharge static pressure in inches wg.
  - e. For each filter bank, filter static-pressure differential in inches wg.
  - f. Cooling-coil static-pressure differential in inches wg.
  - g. Heating-coil static-pressure differential in inches wg.
  - h. List for each internal component with pressure-drop, static-pressure differential in inches wg.
  - i. Outdoor airflow in cfm.
  - j. Return airflow in cfm.
  - k. Outdoor-air damper position.
  - l. Return-air damper position.

F. Apparatus-Coil Test Reports:

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1. Coil Data:
  - a. System identification.
  - b. Location.
  - c. Coil type.
  - d. Number of rows.
  - e. Fin spacing in fins per inch o.c.
  - f. Make and model number.
  - g. Face area in sq. ft..
  - h. Tube size in NPS.
  - i. Tube and fin materials.
  - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.

G. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:
  - a. System identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and unit size.
  - e. Manufacturer's serial number.
  - f. Fuel type in input data.
  - g. Output capacity in Btu/h.
  - h. Ignition type.
  - i. Burner-control types.
2. Test Data (Indicated and Actual Values):
  - a. Low-fire fuel input in Btu/h.
  - b. High-fire fuel input in Btu/h.
  - c. Manifold pressure in psig.
  - d. High-temperature-limit setting in deg F.
  - e. Heating value of fuel in Btu/h.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

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1. Fan Data:
  - a. System identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and size.
  - e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches, and bore.
  - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and speed.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
  - a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan speed.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
  1. Report Data:
    - a. System fan and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft..
    - g. Indicated airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- J. Air-Terminal-Device Reports:
  1. Unit Data:
    - a. System and air-handling unit identification.



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- b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.
    - f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft..
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary airflow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final airflow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
- K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
- 1. Unit Data:
    - a. System and air-handling-unit identification.
    - b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. Water pressure drop in feet of head or psig.
    - e. Entering-air temperature in deg F.
    - f. Leaving-air temperature in deg F.
- L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:
- 1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Service.
    - d. Make and size.
    - e. Model number and serial number.
    - f. Water flow rate in gpm.
    - g. Water pressure differential in feet of head or psig.
    - h. Required net positive suction head in feet of head or psig.

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- i. Pump speed.
  - j. Impeller diameter in inches.
  - k. Motor make and frame size.
  - l. Motor horsepower and rpm.
  - m. Voltage at each connection.
  - n. Amperage for each phase.
  - o. Full-load amperage and service factor.
  - p. Seal type.
2. Test Data (Indicated and Actual Values):
- a. Static head in feet of head or psig.
  - b. Pump shutoff pressure in feet of head or psig.
  - c. Actual impeller size in inches.
  - d. Full-open flow rate in gpm.
  - e. Full-open pressure in feet of head or psig.
  - f. Final discharge pressure in feet of head or psig.
  - g. Final suction pressure in feet of head or psig.
  - h. Final total pressure in feet of head or psig.
  - i. Final water flow rate in gpm.
  - j. Voltage at each connection.
  - k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:
- a. Instrument type and make.
  - b. Serial number.
  - c. Application.
  - d. Dates of use.
  - e. Dates of calibration.

3.20 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of University and Commissioning Authority.
- B. University or University's Representative shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

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- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
  - 2. If the second final inspection also fails, University may pursue others Contract options to complete TAB work.
- F. Prepare test and inspection reports.

3.21 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

## SECTION 230713 – DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, concealed return located in unconditioned space.
  - 3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 4. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 5. Outdoor supply and return.
- B. Related Requirements:
  - 1. Section 230716 "HVAC Equipment Insulation."
  - 2. Section 230719 "HVAC Piping Insulation."
  - 3. Section 233113 "Metal Ducts" for duct liners.

#### 1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any). On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For qualified Installer.

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- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

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1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

## 2.2 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are to be applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

## 2.4 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.

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1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials are compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials are compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

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2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.
- B. Metal Jacket:
  - 1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
- C. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 6.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.10 SECUREMENTS

- A. Bands:
  - 1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
  - 2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.



B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - c. Adhesive-backed base with a peel-off protective cover.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel, aluminum, or stainless steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.

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- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.

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2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

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- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping."
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 INSTALLATION OF GLASS-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
- B. Comply with manufacturer's written installation instructions.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

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- b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

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5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### 3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Comply with manufacturer's written installation instructions.
- B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- C. Insulate duct access panels and doors to achieve same fire rating as duct.
- D. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to

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one location for each duct system defined in the "Duct Insulation Schedule, General" Article.

- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply, return, exhaust, transfer and outdoor air.
  - a. Glass Fiber Blanket 1-1/2 inches thick and 0.75 lb/cu.ft. nominal density.
2. Indoor, exposed, round, supply, return, exhaust, transfer, and outdoor air.
  - a. Glass Fiber Blanket 1-1/2 inches thick and 0.75 lb/cu.ft. nominal density.
3. Indoor, exposed, rectangular, supply, return, exhaust, transfer, and outdoor air:
  - a. Glass Fiber Board: 1-1/2 inches thick and 2.0 lb/cu.ft. nominal density.
4. Outdoor Ductwork:
  - a. Glass Fiber Board: 2 inches thick and 2.0 lb/cu.ft. nominal density.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

C. Plenums and Ducts Not Required to be Insulated:

1. Indoor, exposed, supply, and return air ducts located in air-conditioned spaces.

### 3.10 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

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1. Aluminum, Stucco Embossed: 0.020 inch thick.
2. Self-adhesive outdoor jacket.

END OF SECTION



## SECTION 230719 – HVAC PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
  - 1. Condensate drain piping, indoors.
  - 2. Heating hot-water piping, indoors.
  - 3. Radiant-heating water piping.
  - 4. Refrigerant suction and hot-gas piping indoors and outdoors.
- B. Related Sections:
  - 1. Section 230713 "Duct Insulation."
  - 2. Section 230716 "HVAC Equipment Insulation."

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any). On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Insulation Schedule: Identify type of material, thickness, vapor barrier provision, and where required, field-applied jacket to be provided for each system application.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For qualified Installer.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation

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materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- D. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

#### 1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule" and "Outdoor, Aboveground Piping Insulation Schedule" Articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
- G. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Type I, Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

### 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Adhesives shall have a VOC content of 50 g/L or less.
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

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1. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. ASJ Adhesive Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. VOC Content: 300 g/L or less.
  2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, at dry film thickness.
  2. Service Temperature Range: .
  3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, at dry film thickness.
  2. Service Temperature Range: .
  3. Solids Content: 60 percent by volume and 66 percent by weight.
  4. Color: White.

## 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Adhesives shall have a VOC content of 50 g/L or less.
  2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  4. Service Temperature Range: .
  5. Color: White.

## 2.6 SEALANTS

- A. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: .
  4. Color: White.
  5. Sealant shall have a VOC content of 420 g/L or less.
  6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, Kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.

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2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
  - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

1. Aluminum Jacket: Comply with , Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Factory cut and rolled to size.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: thick, heat-bonded polyethylene and Kraft paper.
  - d. Moisture Barrier for Outdoor Applications: thick, heat-bonded polyethylene and Kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Self-Adhesive Outdoor Jacket: thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Polyguard Products, Inc.; Alumaguard 60.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: .
  2. Thickness: .
  3. Adhesion: in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: in width.

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6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  1. Width: .
  2. Thickness: .
  3. Adhesion: in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: in width.

## 2.10 SECUREMENTS

- A. Bands:
  1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; thick, wide with wing seal or closed seal.
  2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal wide, stainless steel or Monel.
- C. Wire: nickel-copper alloy or soft-annealed, galvanized steel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced o.c.
  - 3. Overlap jacket longitudinal seams at least . Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at o.c.



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- a. For below-ambient services, apply vapor-barrier mastic over staples.
- 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

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- install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
- 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least .
- 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and

- replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:

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1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least , and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

### 3.9 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

### 3.10 FIELD QUALITY CONTROL

A. The General Contractor shall engage a testing agent to perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

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- D. All materials removed during inspections shall be replaced with new materials.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Underground piping.
  - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below :
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: thick.
    - b. Vapor Barrier: Required.
- B. Heating-Hot-, Radiant-Heating Water Supply and Return, Between Boiler and Radiant Heating Manifolds, and Below: and Smaller: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe, Type I: thick.
  - 2. and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe, Type I: thick.
  - 3. Vapor Barrier: Not required.
- C. Radiant PEX tubing between radiant heating manifolds and the floor slab:
  - 1. All pipe sizes shall be:
    - a. Flexible Elastomeric: 1/2-inch thick.
- D. Heating-Hot-Water Supply and Return, above : and Smaller: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe, Type I: thick. and Larger: Insulation shall be the following:
    - b. Mineral-Fiber, Preformed Pipe, Type I: 2 thick.
  - 2. Vapor Barrier: Not required.
- E. Refrigerant Suction and Hot-Gas Piping:

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1. All Pipe Sizes: Insulation shall be the following:
  - a. Flexible Elastomeric: thick.
2. Vapor Barrier: Required.

F. Chilled Water Piping:

1. Pipe Sizes Less Than 1-inch:
  - a. Flexible Elastomeric: 1/2 thick.
2. Pipe Sizes 1-inch and Greater:
  - a. Flexible Elastomeric: thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
  - a. Flexible Elastomeric: thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed:

1. None.

C. Piping, Exposed Piping in Finished Areas:

1. PVC: thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Exposed:

1. For line set covers required for exposed refrigerant piping, both indoor and outdoor refer to Section 238126 "Split-system air-conditioners".

END OF SECTION

SECTION 230923 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. DDC system for monitoring and controlling of HVAC systems.
- 2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.

B. Related Requirements:

- 1. Communications Cabling:
  - a. Section 260523 "Control-Voltage Electrical Power Cables" for balanced twisted pair communications cable.
  - b. Section 271513 "Communications Copper Horizontal Cabling" for balanced twisted pair communications cable.
- 2. Section 260553 "Identification for Electrical Systems" for identification requirements for electrical components.

1.3 DEFINITIONS

- A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.
- B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
- C. BACnet Specific Definitions:
  - 1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
  - 2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
  - 3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.



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4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
  5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.
- D. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.
- E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.
- F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.
- G. COV: Changes of value.
- H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.
- I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.
- J. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.
- K. HLC: Heavy load conditions.
- L. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.
- M. LAN: Local area network.
- N. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- O. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.
- P. MS/TP: Master-slave/token-passing, IEEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
- Q. MTBF: Mean time between failures.

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- R. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.
- S. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
- T. Peer to Peer: Networking architecture that treats all network stations as equal partners.
- U. POT: Portable operator's terminal.
- V. PUE: Performance usage effectiveness.
- W. RAM: Random access memory.
- X. RF: Radio frequency.
- Y. Router: Device connecting two or more networks at network layer.
- Z. Server: Computer used to maintain system configuration, historical and programming database.
- AA. TCP/IP: Transport control protocol/Internet protocol.
- BB. UPS: Uninterruptible power supply.
- CC. USB: Universal Serial Bus.
- DD. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.
- EE. VAV: Variable air volume.
- FF. WLED: White light emitting diode.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Multiple Submissions:
  - 1. If multiple submissions are required to execute work within schedule, first submit a coordinated schedule clearly defining intent of multiple submissions. Include a proposed date of each submission with a detailed description of submittal content to be included in each submission.

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2. Clearly identify each submittal requirement indicated and in which submission the information will be provided.
  3. Include an updated schedule in each subsequent submission with changes highlighted to easily track the changes made to previous submitted schedule.
- C. Product Data: On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied. For each type of product include the following:
1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  3. Product description with complete technical data, performance curves, and product specification sheets.
  4. Installation, operation and maintenance instructions including factors effecting performance.
  5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
  6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
  7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.
- D. Software Submittal. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
  2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
  3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
  4. Description of operator interface to alphanumeric and graphic programming.
  5. Description of each network communication protocol.
  6. Description of system database, including all data included in database, database capacity and limitations to expand database.
  7. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- E. Shop Drawings:
1. General Requirements:
    - a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
    - b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.

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2. Include plans, elevations, sections, and mounting details where applicable.
3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Plan Drawings indicating the following:
  - a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
  - b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
  - c. Each desktop workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, included in Project.
  - d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
  - e. Network communication cable and raceway routing.
  - f. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.
5. Schematic drawings for each controlled HVAC system indicating the following:
  - a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
  - b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
  - c. A graphic showing location of control I/O in proper relationship to HVAC system.
  - d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
  - e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
  - f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
  - g. Narrative sequence of operation.
6. Control panel drawings indicating the following:
  - a. Panel dimensions, materials, size, and location of field cable, raceways, and wiring connections.
  - b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
  - c. Front, rear, and side elevations and nameplate legend.
  - d. Unique drawing for each panel.
7. DDC system network riser diagram indicating the following:
  - a. Each device connected to network with unique identification for each.
  - b. Interconnection of each different network in DDC system.
  - c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.

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- d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.
  8. DDC system electrical power riser diagram indicating the following:
    - a. Each point of connection to field power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
    - b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
    - c. Each product requiring power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
    - d. Power wiring type and size, race type, and size for each.
  9. Monitoring and control signal diagrams indicating the following:
    - a. Control signal cable and wiring between controllers and I/O.
    - b. Point-to-point schematic wiring diagrams for each product.
  10. Color graphics indicating the following:
    - a. Itemized list of color graphic displays to be provided.
    - b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.
    - c. Intended operator access between related hierarchical display screens.
- F. System Description:
  1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
  2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
  3. System and product operation under each potential failure condition including, but not limited to, the following:
    - a. Loss of power.
    - b. Loss of network communication signal.
    - c. Loss of controller signals to inputs and outpoints.
    - d. Operator workstation failure.
    - e. Server failure.
    - f. Gateway failure.
    - g. Network failure
    - h. Controller failure.
    - i. Instrument failure.
    - j. Control damper and valve actuator failure.
  4. Complete bibliography of documentation and media to be delivered to Owner.
  5. Description of testing plans and procedures.
  6. Description of Owner training.

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1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings:
  - 1. Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
    - a. Product installation location shown in relationship to room, duct, pipe and equipment.
    - b. Structural members to which products will be attached.
    - c. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices and other installed devices.
    - d. Size and location of wall access panels for products installed behind walls and requiring access.
  - 2. Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
    - a. Ceiling components.
    - b. Size and location of access panels for products installed above inaccessible ceiling assemblies and requiring access.
    - c. Items penetrating finished ceiling including the following:
      - 1) Lighting fixtures.
      - 2) Air outlets and inlets.
      - 3) Speakers.
      - 4) Sprinklers.
      - 5) Access panels.
      - 6) Motion sensors.
      - 7) Pressure sensors.
      - 8) Temperature sensors and other DDC control system instruments.
- C. Qualification Data:
  - 1. Systems Provider Qualification Data:
    - a. Resume of project manager assigned to Project.
    - b. Resumes of application engineering staff assigned to Project.
    - c. Resumes of installation and programming technicians assigned to Project.
    - d. Resumes of service technicians assigned to Project.
    - e. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.
    - f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
    - g. Names of staff assigned to past project that will also be assigned to execute work of this Project.

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- h. Owner contact information for past project including name, phone number, and e-mail address.
  - i. Contractor contact information for past project including name, phone number, and e-mail address.
  - j. Architect and Engineer contact information for past project including name, phone number, and e-mail address.
- 2. Manufacturer's qualification data.
- 3. Testing agency's qualifications data.
- D. Product Certificates:
  - 1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.
- E. Product Test Reports: For each product that requires testing to be performed by manufacturer.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Sample Warranty: For manufacturer's warranty.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
    - b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
    - c. As-built versions of submittal Product Data.
    - d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
    - e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
    - f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
    - g. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.

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- h. Backup copy of graphic files, programs, and database on electronic media such as DVDs or CDs.
- i. List of recommended spare parts with part numbers and suppliers.
- j. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
- k. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
- l. Licenses, guarantees, and warranty documents.
- m. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- n. Owner training materials.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- C. Include product manufacturers' recommended parts lists for proper product operation over four-year period following warranty period. Parts list shall be indicated for each year.
- D. Furnish parts, as indicated by manufacturer's recommended parts list, for product operation during two-year period following warranty period.
- E. Furnish quantity indicated of matching product(s) in Project inventory for each unique size and type of following:
  - 1. Network Controller: One.
  - 2. Programmable Application Controller: One.
  - 3. Application-Specific Controller: One.
  - 4. Room and Outdoor Carbon Dioxide Sensor and Transmitter: One of each.
  - 5. Transformer: One of each size and type.
  - 6. DC Power Supply: One of each size and type.

1.9 QUALITY ASSURANCE

- A. DDC System Manufacturer Qualifications:
  - 1. Nationally recognized manufacturer of DDC systems and products.
  - 2. DDC systems with similar requirements to those indicated for a continuous period of 10 years within time of bid.
  - 3. DDC systems and products that have been successfully tested and in use on at least five past projects.
  - 4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
  - 5. Having full-time in-house employees for the following:



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- a. Product research and development.
- b. Product and application engineering.
- c. Product manufacturing, testing and quality control.
- d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
- e. Owner operator training.

B. DDC System Provider Qualifications:

1. Authorized representative of, and trained by, DDC system manufacturer.
2. In-place facility located within 50 miles of Project.
3. Demonstrated past experience with installation of DDC system products being installed for period within five consecutive years before time of bid.
4. Demonstrated past experience on five projects of similar complexity, scope and value.
5. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.
6. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
  - a. Install updates only after receiving Owner's written authorization.
3. Warranty service shall occur during normal business hours and commence within 16 hours of Owner's warranty service request.
4. Warranty Period: Three years from date of Substantial Completion.
  - a. For Gateway: Three-year parts and labor warranty for each.

PART 2 - PRODUCTS

2.1 DDC SYSTEM MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Johnson Controls, Inc.
2. Siemens Building Technologies, Inc.
3. Trane.

## 2.2 DDC SYSTEM DESCRIPTION

- A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.
  - 1. DDC system shall consist of a high-speed, peer-to-peer network of distributed DDC controllers, other network devices, operator interfaces, and software.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.3 WEB ACCESS

- A. DDC system shall be Web based.
  - 1. Web-Based Access to DDC System:
    - a. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet through Owner's LAN.
    - b. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
    - c. Web access shall be password protected.

## 2.4 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- B. DDC System Speed:
  - 1. Response Time of Connected I/O:
    - a. AI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
    - b. BI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.

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- c. AO points connected to DDC system shall begin to respond to controller output commands within two seconds. Global commands shall also comply with this requirement.
  - d. BO point values connected to DDC system shall respond to controller output commands within two seconds. Global commands shall also comply with this requirement.
- 2. Display of Connected I/O:
  - a. Analog point COV connected to DDC system shall be updated and displayed at least every 10 seconds for use by operator.
  - b. Binary point COV connected to DDC system shall be updated and displayed at least every 10 seconds for use by operator.
  - c. Alarms of analog and digital points connected to DDC system shall be displayed within 45 seconds of activation or change of state.
  - d. Graphic display refresh shall update within eight seconds.
  - e. Point change of values and alarms displayed from workstation to workstation when multiple operators are viewing from multiple workstations shall not exceed graphic refresh rate indicated.
- C. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.
- D. DDC System Data Storage:
  - 1. Include capability to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
  - 2. Local Storage:
    - a. Provide workstation with data storage indicated. Server(s) shall use IT industry standard database platforms and be capable of functions described in "DDC Data Access" Paragraph.
- E. DDC Data Access:
  - 1. When logged into the system, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
  - 2. System(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.
- F. Future Expandability:
  - 1. DDC system size shall be expandable to an ultimate capacity of at least two times total I/O points indicated.
  - 2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.

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3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.
- G. Input Point Displayed Accuracy: Input point displayed values shall meet following end-to-end overall system accuracy, including errors associated with meter, sensor, transmitter, lead wire or cable, and analog to digital conversion.
1. Energy:
    - a. Thermal: Within 5 percent of reading.
    - b. Electric Power: Within 1 percent of reading.
    - c. Requirements indicated on Drawings for meters not supplied by utility.
  2. Flow:
    - a. Air: Within 5 percent of design flow rate.
    - b. Air (Terminal Units): Within 5 percent of design flow rate.
  3. Gas:
    - a. Carbon Dioxide: Within 50 ppm.
    - b. Carbon Monoxide: Within 5 percent of reading.
    - c. Refrigerant: Within 50 ppm.
  4. Moisture (Relative Humidity):
    - a. Air: Within 3 percent RH.
    - b. Space: Within 3 percent RH.
    - c. Outdoor: Within 3 percent RH.
  5. Level: Within 5 percent of reading.
  6. Pressure:
    - a. Air, Ducts and Equipment: 0.5 percent of instrument range.
    - b. Space: Within 0.25 percent of instrument range.
  7. Speed: Within percent of reading.
  8. Temperature, Dry Bulb:
    - a. Air: Within 1 deg F.
    - b. Space: Within 1 deg F.
    - c. Outdoor: Within 1 deg F.
    - d. Other Temperatures Not Indicated: Within 1 deg F.
- H. Precision of I/O Reported Values: Values reported in database and displayed shall have following precision:
1. Current:
    - a. Milliamperes: Nearest 1/100th of a milliampere.
    - b. Amperes: Nearest 1/10th of an ampere up to 100 A; nearest ampere for 100 A and more.

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2. Energy:
  - a. Electric Power:
    - 1) Rate (Watts): Nearest 1/10th of a watt through 1000 W.
    - 2) Rate (Kilowatts): Nearest 1/10th of a kilowatt through 1000 kW; nearest kilowatt above 1000 kW.
    - 3) Usage (Kilowatt-Hours): Nearest kilowatt through 10,000 kW; nearest 10 kW between 10,000 and 100,000 kW; nearest 100 kW for above 100,000 kW.
  - b. Thermal, Rate:
    - 1) Heating: For Btu/h, nearest Btu/h up to 1000 Btu/h; nearest 10 Btu/h between 1000 and 10,000 Btu/h; nearest 100 Btu/h for above 10,000 Btu/h. For Mbh, round to nearest Mbh up to 1000 Mbh; nearest 10 Mbh between 1000 and 10,000 Mbh; nearest 100 Mbh above 10,000 Mbh.
    - 2) Cooling: For tons, nearest ton up to 1000 tons; nearest 10 tons between 1000 and 10,000 tons; nearest 100 tons above 10,000 tons.
  - c. Thermal, Usage:
    - 1) Heating: For Btu, nearest Btu up to 1000 Btu; nearest 10 Btu between 1000 and 10,000 Btu; nearest 100 Btu for above 10,000 Btu. For Mbtu, round to nearest Mbtu up to 1000 Mbtu; nearest 10 Mbtu between 1000 and 10,000 Mbtu; nearest 100 Mbtu above 10,000 Mbtu.
    - 2) Cooling: For ton-hours, nearest ton-hours up to 1000 ton-hours; nearest 10 ton-hours between 1000 and 10,000 ton-hours; nearest 100 tons above 10,000 tons.
3. Flow:
  - a. Air: Nearest 1/10th of a cfm through 100 cfm; nearest cfm between 100 and 1000 cfm; nearest 10 cfm between 1000 and 10,000 cfm; nearest 100 cfm above 10,000 cfm.
4. Gas:
  - a. Carbon Dioxide (ppm): Nearest ppm.
  - b. Carbon Monoxide (ppm): Nearest ppm.
  - c. Refrigerant (ppm): Nearest ppm.
5. Moisture (Relative Humidity):
  - a. Relative Humidity (Percentage): Nearest 1 percent.
6. Pressure:
  - a. Air, Ducts and Equipment: Nearest 1/10th in. w.c..
  - b. Space: Nearest 1/100th in. w.c..
7. Temperature:

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- a. Air, Ducts and Equipment: Nearest 1/10th of a degree.
  - b. Outdoor: Nearest degree.
  - c. Space: Nearest 1/10th of a degree.
  - d. Heating Hot Water: Nearest degree.
- 8. Voltage: Nearest 1/10 volt up to 100 V; nearest volt above 100 V.
- I. Control Stability: Control variables indicated within the following limits:
  - 1. Flow:
    - a. Air, Ducts and Equipment, except Terminal Units: Within 5 percent of design flow rate.
    - b. Air, Terminal Units: Within 5 percent of design flow rate.
  - 2. Gas:
    - a. Carbon Dioxide: Within 50 ppm.
    - b. Carbon Monoxide: Within 5 percent of reading.
  - 3. Moisture (Relative Humidity):
    - a. Air: Within 5 percent RH.
    - b. Space: Within 5 percent RH.
    - c. Outdoor: Within 5 percent RH.
  - 4. Pressure:
    - a. Air, Ducts and Equipment: 0.5 percent of instrument range.
    - b. Space: Within 0.25 percent of instrument range.
  - 5. Temperature, Dry Bulb:
    - a. Air: Within 0.5 deg F.
    - b. Space: Within 0.5 deg F.
- J. Environmental Conditions for Controllers, Gateways, and Routers:
  - 1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.
    - a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.
  - 2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

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- a. Outdoors, Protected: Type 3.
- b. Outdoors, Unprotected: Type 4.
- c. Indoors, Heated with Filtered Ventilation: Type 1 or Type 2.
- d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
- e. Indoors, Heated and Air Conditioned: Type 1.
- f. Mechanical Equipment Rooms:
  - 1) Air-Moving Equipment Rooms: Type 1.
- g. Localized Areas Exposed to Washdown: Type 4.
- h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2.
- i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.

K. Environmental Conditions for Instruments and Actuators:

- 1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
  - a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and ventilated as required by instrument and application.

L. DDC System Reliability:

- 1. Design, install and configure DDC controllers, devices and to yield a MTBF of at least 40,000 hours, based on a confidence level of at least 90 percent. MTBF value shall include any failure for any reason to any part of products indicated.
- 2. If required to comply with MTBF indicated, include DDC system and product redundancy to maintain DCC system, and associated systems and equipment that are being controlled, operational and under automatic control.
- 3. Critical systems and equipment that require a higher degree of DDC system redundancy than MTBF indicated shall be indicated on Drawings.

M. Electric Power Quality:

- 1. Power-Line Surges:
  - a. Protect DDC system products connected to ac power circuits from power-line surges.
  - b. Do not use fuses for surge protection.
- 2. Power Conditioning:
  - a. Protect susceptible DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:

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- 1) At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
  - 2) During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
  - 3) Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
  - 4) Total harmonic distortion shall not exceed 3-1/2 percent at full load.
3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

N. Backup Power Source:

1. HVAC systems and equipment served by a backup power source shall have associated DDC system products that control such systems and equipment also served from a backup power source.

O. UPS:

1. DDC system products powered by UPS units shall include the following:
  - a. Desktop workstations.
  - b. Printers.
  - c. Servers.

P. Continuity of Operation after Electric Power Interruption:

1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

## 2.5 SYSTEM ARCHITECTURE

A. System architecture shall consist of no more than two levels of LANs.

1. Level one LAN shall connect network controllers and operator workstations.
2. Level one or Level two LAN shall connect programmable application controllers to other programmable application controllers, and to network controllers.
3. Level two LAN shall connect application-specific controllers to programmable application controllers and network controllers.
4. Level two LAN shall connect application-specific controllers to application-specific controllers.

B. DDC system shall consist of dedicated and separated LANs that are not shared with other building systems and tenant data and communication networks.



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- C. System architecture shall be modular and have inherent ability to expand to not less than two times system size indicated with no impact to performance indicated.
- D. System architecture shall perform modifications without having to remove and replace existing network equipment.
- E. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.
- F. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.
- G. Special Network Architecture Requirements:
  - 1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV or CAV terminal units, include a dedicated LAN of application-specific controllers serving VAV or CAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s). Create a DDC system LAN that aligns with air-handling system being controlled.

## 2.6 DDC SYSTEM OPERATOR INTERFACES

- A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:
  - 1. Desktop and portable workstation with hardwired connection through LAN port.
  - 2. Portable operator terminal with hardwired connection through LAN port.
  - 3. Portable operator workstation with wireless connection through LAN router.
  - 4. Mobile device and application with secured wireless connection through LAN router or cellular data service.
  - 5. Remote connection through web access.
- B. Access to system, regardless of operator means used, shall be transparent to operator.
- C. Network Ports: For hardwired connection of desktop or portable workstation. Network port shall be easily accessible, properly protected, clearly labeled, and installed at the following locations:
  - 1. Each mechanical equipment room.
  - 2. Each different roof level with roof-mounted air-handling units or rooftop units.
- D. Mobile Device:
  - 1. Connect to system through a wireless router connected to LAN and cellular data service.
  - 2. Able to communicate with any DDC controller connected to DDC system using a dedicated application and secure web access.
- E. Critical Alarm Reporting:

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1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention.
  2. DDC system shall send alarm notification to multiple recipients that are assigned for each alarm.
  3. DDC system shall notify recipients by any or all means, including e-mail, text message and prerecorded phone message to mobile and landline phone numbers.
- F. Simultaneous Operator Use: Capable of accommodating up to five simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

## 2.7 NETWORK COMMUNICATION PROTOCOL

- A. Network communication protocol(s) used throughout entire DDC system shall be open to Owner and available to other companies for use in making future modifications to DDC system.
- B. ASHRAE 135 Protocol:
1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout entire DDC system.
  2. DDC system shall not require use of gateways except to integrate HVAC equipment and other building systems and equipment, not required to use ASHRAE 135 communication protocol.
  3. If used, gateways shall connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
  4. Operator workstations, controllers and other network devices shall be tested and listed by BACnet Testing Laboratories.
- C. Industry Standard Protocols:
1. DDC system shall use any one or a combination of the following industry standard protocols for network communication while complying with other DDC system requirements indicated:
    - a. ASHRAE 135.
  2. Operator workstations and network controllers shall communicate through ASHRAE 135 protocol.
  3. Portions of DDC system networks using ASHRAE 135 communication protocol shall be an open implementation of network devices complying with ASHRAE 135. Network devices shall be tested and listed by BACnet Testing Laboratories.

## 2.8 DESKTOP WORKSTATIONS

- A. Description: A tower or all-in-one computer designed for normal use at a single, semipermanent location.
- B. Performance Requirements:

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1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
2. Energy Star compliant.

C. Personal Computer:

1. Minimum Processor Speed: 5.4 GHz.
2. RAM:
  - a. Capacity: 16 GB.
3. Hard Drive:
  - a. Media: Rotating disc, nominal rotational speed of 7200 rpm.
  - b. Number of Hard Drives: One.
  - c. Capacity: 1 TB.
4. Network Interface Card: Include card with connection, as applicable.
  - a. 10-100-1000 base TX Ethernet with RJ45 connector port.

D. Keyboard:

1. 101 enhanced keyboard.
2. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad, and 12 programmable function keys.

E. Pointing Device:

1. Either a two- or three-button mouse.

## 2.9 PORTABLE WORKSTATIONS

- A. Description: A self-contained computer designed to allow for normal use in different locations and conditions.

B. Performance Requirements:

1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
2. Energy Star compliant.
3. Hardware and software shall support local down-loading to DDC controllers.
4. Data transfer rate to DDC controller shall be at network speed.

C. Processor:

1. Minimum Processor Speed: 4.7 GHz.
2. RAM:
  - a. Capacity: 16 GB.

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3. Hard Drive:

- a. Number of Hard Drives: One.
- b. Capacity: 500 GB.

D. Input and Output Ports:

1. Four USB 3.0 ports.
2. HDMI port.

E. Battery:

1. Battery life of at least three years.
2. Battery charge time of less than three hours.

F. Keyboard:

1. 85-key backlit keyboard.
2. Full upper- and lowercase ASCII keyset.

G. Integral Pointing Device: Touchpad with two buttons. Gesture enabled.

H. Display:

1. Antiglare screen.
2. 1920 by 1080 pixel resolution.

I. Network Interfaces:

1. Network Interface Card: Include card with connection, as application.
  - a. 10-100-1000 base TX Ethernet with RJ45 connector port.

J. Accessories:

1. Nylon carrying case.
2. Wireless optical mouse.
3. HDMI cable. Minimum cable length shall be 6 feet.

2.10 PRINTERS

A. Color Inkjet Printer:

1. Inkjet technology with true four-color printing (black, cyan, magenta, and yellow).
2. Print quality of 1200 by 600 dots per inch with black on inkjet paper and 4800 by 1200 dots per inch color printing on premium photo paper.

2.11 SYSTEM SOFTWARE

A. System Software Minimum Requirements:

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1. Real-time multitasking and multiuser 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
3. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
4. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
5. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language pronouncing and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.
3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.
5. Security Access:
  - a. Operator access to DDC system shall be under password control.
  - b. An alphanumeric password shall be field assignable to each operator.
  - c. Operators shall be able to access DDC system by entry of proper password.
  - d. Operator password shall be same regardless of which computer or other interface means is used.
  - e. Additions or changes made to passwords shall be updated automatically.
  - f. Each operator shall be assigned an access level to restrict access to data and functions the operator is capable of performing.
  - g. Software shall have at least five access levels.
  - h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.
  - i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.
6. Operators shall be able to perform commands including, but not limited to, the following:
  - a. Start or stop selected equipment.
  - b. Adjust set points.
  - c. Add, modify, and delete time programming.
  - d. Enable and disable process execution.
  - e. Lock and unlock alarm reporting for each point.
  - f. Enable and disable totalization for each point.
  - g. Enable and disable trending for each point.
  - h. Override control loop set points.

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- i. Enter temporary override schedules.
  - j. Define holiday and event schedules.
  - k. Change time and date.
  - l. Enter and modify analog alarm limits.
  - m. Enter and modify analog warning limits.
  - n. View limits.
  - o. Enable and disable demand limiting.
- 7. Reporting:
  - a. Generated automatically and manually.
  - b. Sent to displays, printers and disk files.
  - c. Types of Reporting:
    - 1) General listing of points.
    - 2) List points currently in alarm.
    - 3) List of off-line points.
    - 4) List points currently in override status.
    - 5) List of disabled points.
    - 6) List points currently locked out.
    - 7) List weekly schedules.
    - 8) List holiday programming.
- 8. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.

C. Graphic Interface Software:

- 1. Include a full interactive graphical selection means of accessing and displaying system data to operator. Include at least five levels with the penetration path operator assignable (for example, site, building, floor, air-handling unit, and supply temperature loop). Native language descriptors assigned to menu items are to be operator defined and modifiable under password control.
- 2. Include a hierarchical-linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. Interface shall use a pointing device with pull-down or penetrating menus, color and animation to facilitate operator understanding of system.
- 3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.
- 4. Descriptors for graphics, points, alarms and such shall be modified through operator's workstation under password control.
- 5. Graphic displays shall be online user definable and modifiable using the hardware and software provided.
- 6. Data to be displayed within a graphic shall be assignable regardless of physical hardware address, communication or point type.
- 7. Graphics are to be online programmable and under password control.
- 8. Points may be assignable to multiple graphics where necessary to facilitate operator understanding of system operation.
- 9. Graphics shall also contain software points.
- 10. Penetration within a graphic hierarchy shall display each graphic name as graphics are selected to facilitate operator understanding.
- 11. Display operator accessed data on the monitor.

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12. Operator shall select further penetration using pointing device to click on a site, building, floor, area, equipment, and so on. Defined and linked graphic below that selection shall then be displayed.
  13. Dynamic data shall be assignable to graphics.
  14. Use color, rotation, or other highly visible means, to denote status and alarm states. Color shall be variable for each class of points, as chosen by operator.
  15. Points shall be dynamic update rates on a per point basis.
  16. For operators with appropriate privilege, points shall be commanded directly from display using pointing device.
- D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:
1. Site plan showing each building, and additional site elements, which are being controlled or monitored by DDC system.
  2. Plan for each building floor and the roof, showing the following:
    - a. Room layouts with room identification and name.
    - b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by DDC system.
    - c. Location and identification of each hardware point being controlled or monitored by DDC system.
  3. Control schematic for each of following, including a graphic system schematic representation, similar to that indicated on Drawings, with point identification, set point and dynamic value indication, sequence of operation and controller wiring diagram.
  4. Graphic display for each piece of equipment connected to DDC system through a data communications link. Include dynamic indication of all points associated with equipment.
  5. DDC system network riser diagram that shows schematic layout for entire system including all networks and all controllers, operator workstations and other network devices.
- E. Customizing Software:
1. Software to modify and tailor DDC system to specific and unique requirements of equipment installed, to programs implemented and to staffing and operational practices planned.
  2. Online modification of DDC system configuration, program parameters, and database using menu selection and keyboard entry of data into preformatted display templates.
  3. As a minimum, include the following modification capability:
    - a. Operator assignment shall include designation of operator passwords, access levels, point segregation and auto sign-off.
    - b. System text addition and change capability shall include English or native language descriptors for points and access levels and action messages for alarms, run time and trouble condition.
    - c. Time and schedule change capability shall include time and date set, time and occupancy schedules, exception and holiday schedules and daylight savings time schedules.
    - d. Point related change capability shall include the following:
      - 1) System and point enable and disable.
      - 2) Assignment of alarm and warning limits.

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e. Application program change capability shall include the following:

1) Programming changes.

4. Software shall allow operator to add points, or groups of points, to DDC system and to link them to energy optimization and management programs. Additions and modifications shall be online programmable using operator workstation, downloaded to other network devices and entered into their databases. After verification of point additions and associated program operation, database shall be uploaded and recorded on hard drive and disk for archived record.

F. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers and other network devices.
2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.
3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
4. Alarms display shall include the following:
  - a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
  - b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
  - c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."
  - d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.
5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and assignments.
6. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.

G. Reports and Logs:

1. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
2. Each report shall be definable as to data content, format, interval and date.
3. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation for historical reporting.
4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
5. Reports and logs shall be stored on workstation hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.



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6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.
- H. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.
1. All I/O: With current status and values.
  2. Alarm: All current alarms, except those in alarm lockout.
  3. Disabled I/O: All I/O points that are disabled.
  4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
  5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
  6. Logs:
    - a. Alarm history.
    - b. System messages.
    - c. System events.
    - d. Trends.
- I. Standard Trends:
1. Trend all I/O point present values, set points, and other parameters indicated for trending.
  2. Trends shall be associated into groups, and a trend report shall be set up for each group.
  3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75 percent of DDC controller buffer limit, or by operator request, or by archiving time schedule.
  4. Preset trend intervals for each I/O point after review with Owner.
  5. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Minimum number of consecutive trend values stored at one time shall be 100 per variable.
  6. When drive storage memory is full, most recent data shall overwrite oldest data.
  7. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.
- J. Programming Software:
1. Include programming software to execute sequences of operation indicated.
  2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
  3. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.

2.12 ASHRAE 135 GATEWAYS

- A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, boilers, and variable-speed drives.

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2.13 DDC CONTROLLERS

- A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.
- B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.
- C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.
- D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.
- E. Environment Requirements:
  - 1. Controller hardware shall be suitable for the anticipated ambient conditions.
- F. Power and Noise Immunity:
  - 1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
  - 2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.
- G. DDC Controller Spare Processing Capacity:
  - 1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:
    - a. Network Controllers: 50 percent.
    - b. Programmable Application Controllers: Not less than 60 percent.
    - c. Application-Specific Controllers: Not less than 70 percent.
- H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:
  - 1. Network Controllers:
    - a. 10 percent of each AI, AO, BI, and BO point connected to controller.
    - b. Minimum Spare I/O Points per Controller:
      - 1) AIs: Two.
      - 2) AOs: Two.
      - 3) BIs: Three.
      - 4) BOs: Three.
  - 2. Programmable Application Controllers:
    - a. 10 percent of each AI, AO, BI, and BO point connected to controller.
    - b. Minimum Spare I/O Points per Controller:

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- 1) AIs: Three.
  - 2) AOs: Three.
  - 3) BIs: Three.
  - 4) BOs: Three.
3. Application-Specific Controllers:
  - a. 10 percent of each AI, AO, BI, and BO point connected to controller.
  - b. Minimum Spare I/O Points per Controller:
    - 1) AIs: One.
    - 2) AOs: One.
    - 3) BIs: One.
    - 4) BOs: One.
- I. Maintenance and Support: Include the following features to facilitate maintenance and support:
  1. Mount microprocessor components on circuit cards for ease of removal and replacement.
  2. Means to quickly and easily disconnect controller from network.
  3. Means to quickly and easily access connect to field test equipment.
  4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.
- J. Input and Output Point Interface:
  1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.
  2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
  3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.
  4. AIs:
    - a. AIs shall include monitoring of low-voltage (zero- to 10-V dc), current (4 to 20 mA) and resistance signals from thermistor and RTD sensors.
    - b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
    - c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
    - d. Signal conditioning including transient rejection shall be provided for each AI.
    - e. Capable of being individually calibrated for zero and span.
    - f. Incorporate common-mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal-mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10000 ohms.
  5. AOs:
    - a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.

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- b. Output signals shall have a range of 4 to 20 mA dc or zero- to 10-V dc as required to include proper control of output device.
  - c. Capable of being individually calibrated for zero and span.
  - d. AOs shall not exhibit a drift of greater than 0.4 percent of range per year.
  - e. Network and programmable application controller AOs shall be equipped with individual H-O-A switches and output adjustment potentiometers for use in the hand position.
- 6. BIs:
  - a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
  - b. Isolation and protection against an applied steady-state voltage of up to 180-V ac peak.
  - c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
  - d. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
  - e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided to totalize pulses. Pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operator's command.
- 7. BOs:
  - a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.
    - 1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V ac.
    - 2) Triac outputs shall include at least 180 V of isolation. Minimum contact rating shall be 1 A at 24-V ac.
  - b. BOs shall include for two-state operation or a pulsed low-voltage signal for pulse-width modulation control.
  - c. BOs shall be selectable for either normally open or normally closed operation.
  - d. Include tristate outputs (two coordinated BOs) for control of three-point floating-type electronic actuators without feedback.
  - e. Limit use of three-point floating devices to VAV terminal unit control applications. Control algorithms shall operate actuator to one end of its stroke once every 24 hours for verification of operator tracking.

## 2.14 NETWORK CONTROLLERS

### A. General Network Controller Requirements:

- 1. Include adequate number of controllers to achieve performance indicated.

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2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
7. Controllers shall be fully programmable.

B. Communication:

1. Network controllers shall communicate with other devices on DDC system Level one network.
2. Network controller also shall perform routing if connected to a network of programmable application and application-specific controllers.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or mobile device.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 96 hours.

## 2.15 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
6. Controllers shall be fully programmable.

B. Communication:

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1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or mobile device.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

## 2.16 APPLICATION-SPECIFIC CONTROLLERS

- A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.

1. Capable of standalone operation and shall continue to include control functions without being connected to network.
2. Data shall be shared between networked controllers and other network devices.

- B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

- C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation. Connection shall extend to port on space temperature sensor that is connected to controller.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

## 2.17 CONTROLLER SOFTWARE

- A. General Controller Software Requirements:

1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.

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2. I/O points shall be identified by up to 30-character point name and up to 16-character point descriptor. Same names shall be used at operator workstations.
  3. Control functions shall be executed within controllers using DDC algorithms.
  4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.
- B. Security:
1. Operator access shall be secured using individual security passwords and user names.
  2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
  3. Operator log-on and log-off attempts shall be recorded.
  4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.
- C. Scheduling: Include capability to schedule each point or group of points in system.
- D. System Coordination:
1. Include standard application for proper coordination of equipment.
  2. Application shall include operator with a method of grouping together equipment based on function and location.
  3. Group may then be used for scheduling and other applications.
- E. Binary Alarms:
1. Each binary point shall be set to alarm based on operator-specified state.
  2. Include capability to automatically and manually disable alarming.
- F. Analog Alarms:
1. Each analog object shall have both high and low alarm limits.
  2. Alarming shall be able to be automatically and manually disabled.
- G. Alarm Reporting:
1. Operator shall be able to determine action to be taken in event of an alarm.
  2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
  3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.
- H. Remote Communication:
1. System shall have ability to dial out in the event of an alarm.
- I. Maintenance Management: System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.
- J. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.

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K. Control Loops:

1. Support any of the following control loops, as applicable to control required:
  - a. Two-position (on/off, open/close, slow/fast) control.
  - b. Proportional control.
  - c. Proportional plus integral (PI) control.
  - d. Proportional plus integral plus derivative (PID) control.
    - 1) Include PID algorithms with direct or reverse action and anti-windup.
    - 2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
    - 3) Controlled variable, set point, and PID gains shall be operator-selectable.
  - e. Adaptive (automatic tuning).

- L. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.

M. Anti-Short Cycling:

1. BO points shall be protected from short cycling.
2. Feature shall allow minimum on-time and off-time to be selected.

N. On and Off Control with Differential:

1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.

O. Run-Time Totalization:

1. Include software to totalize run-times for all BI and BO points.
2. A high run-time alarm shall be assigned, if required, by operator.

## 2.18 ENCLOSURES

A. General Enclosure Requirements:

1. House each controller and associated control accessories in an enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
2. Do not house more than one controller in a single enclosure.
3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
4. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as required.
5. Supply each enclosure with a complete set of as-built schematics and wiring diagrams and product literature located in a pocket on inside of door.



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B. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.

2.19 RELAYS

A. General-Purpose Relays:

1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
3. Relays shall have LED indication.

B. Current Sensing Relay:

1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current is adjustable from 50 to 95 percent of pickup current.

2.20 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
2. Transformer shall be at least 40 VA.
3. Transformer shall have both primary and secondary fuses.

B. Power-Line Conditioner:

1. General Power-Line Conditioner Requirements:
  - a. Design to ensure maximum reliability, serviceability and performance.
  - b. Overall function of the power-line conditioner is to receive raw, polluted electrical power and purify it for use by electronic equipment. The power-line conditioner shall provide isolated, regulated, transient and noise-free sinusoidal power to loads served.
2. Standards: NRTL listed per UL 1012.

2.21 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS FOR WORKSTATIONS

A. 250 through 1000 VA:

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1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
  2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
    - a. Larger-capacity units shall be provided for systems with larger connected loads.
    - b. UPS shall provide five minutes of battery power.
  3. Performance:
    - a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
    - b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
    - c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
    - d. On Battery Output Voltage: Sine wave.
    - e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
    - f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
    - g. Transfer Time: 6 ms.
    - h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.
  4. UPS shall be automatic during fault or overload conditions.
  5. Unit with integral line-interactive, power condition topology to eliminate all power contaminants.
  6. Include front panel with power switch and visual indication of power, battery, fault and temperature.
  7. Unit shall include an audible alarm of faults and front panel silence feature.
  8. Unit with four NEMA WD 1, NEMA WD 6 Configuration 5-15R receptacles.
  9. Batteries shall be sealed lead-acid type and be maintenance free. Battery replacement shall be front accessible by user without dropping load.
  10. Include tower models installed in ventilated cabinets to the particular installation location.
- B. 1000 through 3000 VA:
1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
  2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
    - a. Larger-capacity units, or multiple units, shall be provided for systems with larger connected loads.
    - b. UPS shall provide five minutes of battery power.
  3. Performance:
    - a. Input Voltage: Single phase, 120-V ac, plus 20 to minus 30 percent.
    - b. Power Factor: Minimum 0.97 at full load.
    - c. Output Voltage: Single phase, 120-V ac, within 3 percent, steady state with rated output current of 10.0 A, 30.0-A peak.

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- d. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
- e. Recharge time shall be a maximum of eight hours to 90 percent capacity.
- 4. UPS bypass shall be automatic during fault or overload conditions.
- 5. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure).
- 6. Batteries shall be sealed lead-acid type and be maintenance free.
- 7. Include tower models installed in ventilated cabinets or rack models installed on matching racks, as applicable to the particular installation location and space availability/configuration.

2.22 CONTROL WIRE AND CABLE

- A. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.
  - 1. Cable shall be balanced twisted pair.
  - 2. Comply with the following requirements and for balanced twisted pair cable described in Section 260523 "Control-Voltage Electrical Power Cables" and Section 271513 "Communications Copper Horizontal Cabling."
    - a. Cable shall be plenum rated.
    - b. Cable shall have a unique color that is different from other cables used on Project.

2.23 RACEWAYS

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.
- B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for raceways for balanced twisted pair cables and optical fiber cables.
- C. Provide junction boxes for wall-mounted thermostats and wall-mounted temperature sensors, and provide conduit from junction box to an accessible location above a ceiling.

2.24 ACCESSORIES

- A. Damper Blade Limit Switches:
  - 1. Sense positive open and/or closed position of the damper blades.
  - 2. NEMA 250, Type 13, oil-tight construction.
  - 3. Arrange for the mounting application.
  - 4. Additional waterproof enclosure when required by its environment.
  - 5. Arrange to prevent "over-center" operation.

2.25 IDENTIFICATION

- A. Control Equipment, Instruments, and Control Devices:

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1. Self-adhesive label bearing unique identification.
  - a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.
2. Letter size shall be as follows:
  - a. Operator Workstations: Minimum of 0.5 inch high.
  - b. Printers: Minimum of 0.5 inch high.
  - c. DDC Controllers: Minimum of 0.5 inch high.
  - d. Repeaters: Minimum of 0.5 inch high.
  - e. Enclosures: Minimum of 0.5 inch high.
  - f. Electrical Power Devices: Minimum of 0.25 inch high.
  - g. UPS units: Minimum of 0.5 inch high.
  - h. Accessories: Minimum of 0.25 inch high.
  - i. Instruments: Minimum of 0.25 inch high.
  - j. Control Damper and Valve Actuators: Minimum of 0.25 inch high.
3. Legend shall consist of white lettering on black background.
4. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require additional identification.

B. Raceway and Boxes:

1. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.

C. Equipment Warning Labels:

1. Self-adhesive label with pressure-sensitive adhesive back and peel-off protective jacket.
2. Lettering size shall be at least 14-point type with white lettering on red background.
3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch beyond white border.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. Verify compatibility with and suitability of substrates.

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- B. Examine roughing-in for products to verify actual locations of connections before installation.
  - 1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
  - 2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

- A. Communication Interface to Equipment with Integral Controls:
  - 1. DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.

3.3 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

- A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.
- B. Deliver the following to duct fabricator and Installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.
  - 1. DDC control dampers, which are specified in Section 230923.12 "DDC Control Dampers."
  - 2. Airflow sensors and switches, which are specified in Section 230923.14 "Flow Instruments."
  - 3. Pressure sensors, which are specified in Section 230923.23 "Pressure Instruments."

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Install products to satisfy more stringent of all requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Support products, piping wiring, and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a force.
- D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

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- E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- F. Firestop Penetrations Made in Fire-Rated Assemblies: Comply with requirements in Section 078413 "Penetration Firestopping."
- G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079219 "Acoustical Joint Sealants."
- H. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  - 3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.
- I. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

### 3.5 WORKSTATION INSTALLATION

- A. Desktop Workstations Installation:
  - 1. Install workstation(s) at location(s) directed by Owner.
  - 2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.
  - 3. Install software on workstation(s) and verify software functions properly.
  - 4. Develop Project-specific graphics, trends, reports, logs and historical database.
  - 5. Power each workstation through a dedicated UPS unit. Locate UPS adjacent to workstation.
- B. Portable Workstations Installation:
  - 1. Turn over portable workstations to Owner at Substantial Completion.
  - 2. Install software on workstation(s) and verify software functions properly.
- C. Color Graphics Application:
  - 1. Use system schematics indicated as starting point to create graphics.
  - 2. Develop Project-specific library of symbols for representing system equipment and products.
  - 3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
  - 4. Submit sketch of graphic layout with description of all text for each graphic for Owner's and Architect's review before creating graphic using graphics software.
  - 5. Seek Owner input in graphics development once using graphics software.
  - 6. Final editing shall be done on-site with Owner's and Architect's review and feedback.
  - 7. Refine graphics as necessary for Owner acceptance.

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8. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

### 3.6 PRINTER INSTALLATION

- A. Provide the following printer(s) at location(s) directed by Owner:
  1. Color Inkjet: Quantity, one.
- B. Install printer software on workstations and verify that software functions properly.

### 3.7 ROUTER INSTALLATION

- A. Install routers if required for DDC system communication interface requirements indicated.
  1. Install router(s) required to suit indicated requirements.
- B. Test router to verify that communication interface functions properly.

### 3.8 CONTROLLER INSTALLATION

- A. Install controllers in enclosures to comply with indicated requirements.
- B. Connect controllers to field power supply.
- C. Install controller with latest version of applicable software and configure to execute requirements indicated.
- D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.
- E. Installation of Network Controllers:
  1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  2. Install controllers in a protected location that is easily accessible by operators.
  3. Top of controller shall be within 84 inches of finished floor.
- F. Installation of Programmable Application Controllers:
  1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  2. Install controllers in a protected location that is easily accessible by operators.
  3. Top of controller shall be within 84 inches of finished floor.
- G. Application-Specific Controllers:

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1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

3.9 INSTALLATION OF WIRELESS ROUTERS FOR OPERATOR INTERFACE

- A. Install wireless routers to achieve optimum performance and best possible coverage.
- B. Mount wireless routers in a protected location that is within 60 inches of floor and easily accessible by operators.

3.10 ELECTRIC POWER CONNECTIONS

- A. Connect electrical power to DDC system products requiring electrical power connections.
- B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.
- C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.
- D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.
- E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

3.11 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification products and installation.
- B. Install unique instrument identification on face of each instrument connected to a DDC controller.
- C. Install unique identification on face of each control damper and valve actuator connected to a DDC controller.
- D. Warning Labels and Signs:
  1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
  2. Shall be located in highly visible location near power service entry points.



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3.12 NETWORK INSTALLATION

- A. Install cable in continuous raceway.
  - 1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.13 NETWORK NAMING AND NUMBERING

- A. Coordinate with Owner and provide unique naming and addressing for networks and devices.
- B. ASHRAE 135 Networks:
  - 1. MAC Address:
    - a. Every network device shall have an assigned and documented MAC address unique to its network.
    - b. Ethernet Networks: Document MAC address assigned at its creation.
    - c. ARCNET or MS/TP networks: Assign from 00 to 64.
  - 2. Network Numbering:
    - a. Assign unique numbers to each new network.
    - b. Provide ability for changing network number through device switches or operator interface.
    - c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.

3.14 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

- A. Comply with NECA 1.
- B. Wire and Cable Installation:
  - 1. Comply with installation requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- C. Conduit Installation:
  - 1. Comply with Section "260533 "Raceways and Boxes for Electrical Systems" for control-voltage conductors.

3.15 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.16 DDC SYSTEM I/O CHECKOUT PROCEDURES

- A. Check installed products before continuity tests, leak tests and calibration.
- B. Check instruments for proper location and accessibility.
- C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
- D. Control Damper Checkout:
  1. Verify that control dampers are installed correctly for flow direction.
  2. Verify that proper blade alignment, either parallel or opposed, has been provided.
  3. Verify that damper frame attachment is properly secured and sealed.
  4. Verify that damper actuator and linkage attachment is secure.
  5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
  6. Verify that damper blade travel is unobstructed.
- E. Instrument Checkout:
  1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
  2. Verify that attachment is properly secured and sealed.
  3. Verify that conduit connections are properly secured and sealed.
  4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
  5. Inspect instrument tag against approved submittal.
  6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
  7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
  8. For temperature instruments:
    - a. Verify sensing element type and proper material.
    - b. Verify length and insertion.

3.17 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

- A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
- B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

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- C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
- D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.
- E. Provide diagnostic and test equipment for calibration and adjustment.
- F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
- G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
- H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
- I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.
- J. Analog Signals:
  - 1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
  - 2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
  - 3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.
- K. Digital Signals:
  - 1. Check digital signals using a jumper wire.
  - 2. Check digital signals using an ohmmeter to test for contact making or breaking.
- L. Control Dampers:
  - 1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
  - 2. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
  - 3. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
- M. Meters: Check sensors at zero, 50, and 100 percent of Project design values.
- N. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.
- O. Switches: Calibrate switches to make or break contact at set points indicated.
- P. Transmitters:
  - 1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.

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2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.18 DDC SYSTEM CONTROLLER CHECKOUT

- A. Verify power supply.
  1. Verify voltage, phase and hertz.
  2. Verify that protection from power surges is installed and functioning.
  3. Verify that ground fault protection is installed.
  4. If applicable, verify if connected to UPS unit.
  5. If applicable, verify if connected to a backup power source.
  6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.
- B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.
- C. Verify that spare I/O capacity is provided.

3.19 DDC CONTROLLER I/O CONTROL LOOP TESTS

- A. Testing:
  1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
  2. Test every I/O point throughout its full operating range.
  3. Test every control loop to verify operation is stable and accurate.
  4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
  5. Test and adjust every control loop for proper operation according to sequence of operation.
  6. Test software and hardware interlocks for proper operation. Correct deficiencies.
  7. Operate each analog point at the following:
    - a. Upper quarter of range.
    - b. Lower quarter of range.
    - c. At midpoint of range.
  8. Exercise each binary point.
  9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
  10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desired results.

### 3.20 DDC SYSTEM VALIDATION TESTS

- A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.
- B. After approval of Test Plan, execute all tests and procedures indicated in plan.
- C. After testing is complete, submit completed test checklist.
- D. Pretest Checklist: Submit the following list with items checked off once verified:
  - 1. Detailed explanation for any items that are not completed or verified.
  - 2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
  - 3. HVAC equipment motors operate below full-load amperage ratings.
  - 4. Required DDC system components, wiring, and accessories are installed.
  - 5. Installed DDC system architecture matches approved Drawings.
  - 6. Control electric power circuits operate at proper voltage and are free from faults.
  - 7. Required surge protection is installed.
  - 8. DDC system network communications function properly, including uploading and downloading programming changes.
  - 9. Each controller's programming is backed up.
  - 10. Equipment, products, tubing, wiring cable and conduits are properly labeled.
  - 11. All I/O points are programmed into controllers.
  - 12. Testing, adjusting and balancing work affecting controls is complete.
  - 13. Dampers and actuators zero and span adjustments are set properly.
  - 14. Each control damper and actuator goes to failed position on loss of power.
  - 15. Meter, sensor and transmitter readings are accurate and calibrated.
  - 16. Control loops are tuned for smooth and stable operation.
  - 17. View trend data where applicable.
  - 18. Each controller works properly in standalone mode.
  - 19. Safety controls and devices function properly.
  - 20. Interfaces with fire-alarm system function properly.
  - 21. Electrical interlocks function properly.
  - 22. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
  - 23. Record Drawings are completed.
- E. Test Plan:
  - 1. Prepare and submit a validation test plan including test procedures for performance validation tests.
  - 2. Test plan shall address all specified functions of DDC system and sequences of operation.
  - 3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
  - 4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
  - 5. Include a test checklist to be used to check and initial that each test has been successfully completed.
  - 6. Submit test plan documentation 20 business days before start of tests.
- F. Validation Test:

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1. Verify operating performance of each I/O point in DDC system.
  - a. Verify analog I/O points at operating value.
  - b. Make adjustments to out-of-tolerance I/O points.
    - 1) Identify I/O points for future reference.
    - 2) Simulate abnormal conditions to demonstrate proper function of safety devices.
    - 3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.
2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:
  - a. Re-check I/O points that required corrections during initial test.
  - b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.
5. After 24 Hours of Second Validation Test:
  - a. Re-check I/O points that required corrections during second test.
  - b. Continue validation testing until I/O point is normal on two consecutive tests.
6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

3.21 FINAL REVIEW

- A. Submit written request to Architect and Owner when DDC system is ready for final review. Written request shall state the following:
  1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
  2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
  3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
  4. DDC system is complete and ready for final review.
- B. Review by Architect and Owner shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.
- C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

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- D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.
- E. Prepare and submit closeout submittals and begin procedures indicated in "Extended Operation Test" Article when no deficiencies are reported.
- F. A part of DDC system final review shall include a demonstration to parties participating in final review.
  - 1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
  - 2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.

3.22 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.23 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by DDC system manufacturer's authorized service representative. Include monthly preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.24 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access system and to upgrade computer equipment if necessary.

3.25 DEMONSTRATION

- A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

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B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:
  - a. Provide not less than five days of training total.
  - b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.

C. Training Schedule:

1. Schedule training with Owner 20 business days before expected Substantial Completion.
2. Schedule training to provide Owner with at least 15 business days of notice in advance of training.
3. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions. Each morning session and afternoon session shall be split in half with 15-minute break between sessions. Morning and afternoon sessions shall be separated by 30-minute lunch period. Training, including breaks and excluding lunch period, shall not exceed eight hours per day.
4. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:

1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.

E. Training Attendee Headcount:

1. Plan in advance of training for five attendees.
2. Make allowance for Owner to add up to two attendees at time of training.
3. Headcount may vary depending on training content covered in session. Attendee access may be restricted to some training content for purposes of maintaining system security.

F. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.

G. Instructor Requirements:

1. One or multiple qualified instructors, as required, to provide training.
2. Instructors shall have not less than five years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.



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H. Training Content for Daily Operators:

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control drawings.
11. Understanding physical location and placement of DDC controllers and I/O hardware.
12. Accessing data from DDC controllers.
13. Operating portable operator workstations.
14. Running each specified report and log.
15. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
16. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
17. Executing digital and analog commands in graphic mode.
18. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
19. Demonstrating DDC system performance through trend logs and command tracing.
20. Demonstrating on-line user guide, and help function and mail facility.

END OF SECTION

SECTION 230923.11 – CONTROL VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes control valves and actuators for DDC systems.
- B. Related Requirements:
  - 1. Section 230923 "Direct-Digital Control System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 DEFINITIONS

- A. Cv: Design valve coefficient.
- B. DDC: Direct-digital control.
- C. NBR: Nitrile butadiene rubber.
- D. PTFE: Polytetrafluoroethylene
- E. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Product Data: For each type of product, including the following:
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control

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signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation, and maintenance instructions, including factors affecting performance.

## 1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For control valves to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.
- C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.
- D. Determine control valve sizes and flow coefficients by ISA 75.01.01.
- E. Control valve characteristics and rangeability shall comply with ISA 75.11.01.
- F. Selection Criteria:
  1. Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.
  2. Valve pattern, three-way or straight through, shall be as indicated on Drawings.
  3. Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.
  4. Modulating three-way pattern water valves shall have linear flow-throttling characteristics. The total flow through the valve shall remain constant regardless of the valve's position.
  5. Fail positions unless otherwise indicated:
    - a. Heating Hot Water: Open.
    - b. Terminal Unit Reheat Valve: Last position.

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6. Globe-type control valves shall pass the design flow required with not more than 95 percent of stem lift unless otherwise indicated.
7. Rotary-type control valves, such as ball valves, shall have Cv falling between 65 and 75 degrees of valve full open position and minimum valve Cv between 15 and 25 percent of open position.
8. Selection shall consider viscosity, flashing, and cavitation corrections.
9. Valves shall have stable operation throughout full range of operation, from design to minimum Cv.
10. In water systems, select modulating control valves for a design Cv based on a pressure drop of 3 psig at design flow unless otherwise indicated.
11. Two-position control valves shall be line size unless otherwise indicated.
12. In water systems, use ball- or globe-style control valves for two-position control.

## 2.2 BALL-STYLE CONTROL VALVES

### A. Ball Valves with Single Port and Characterized Disk:

1. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
2. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
3. Close-off Pressure: 200 psig.
4. Process Temperature Range: Zero to 212 deg F.
5. Body and Tail Piece: Cast bronze ASTM B 61, ASTM B 62, ASTM B 584, or forged brass with nickel plating.
6. End Connections: Threaded (NPT) ends.
7. Ball: Chrome-plated brass or bronze or 300 series stainless steel.
8. Stem and Stem Extension:
  - a. Material to match ball.
  - b. Blowout-proof design.
  - c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.
9. Ball Seats: Reinforced PTFE.
10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
11. Flow Characteristic: Equal percentage.

### B. Ball valves shall not be used for 3-way valve applications.

## 2.3 GLOBE-STYLE CONTROL VALVES

### A. General Globe-Style Valve Requirements:

1. Globe-style control valve body dimensions shall comply with ISA 75.08.01.
2. Construct the valves to be serviceable from the top.
3. For cage guided valves, trim shall be field interchangeable for different valve flow characteristics, such as equal percentage, linear, and quick opening.

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4. Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1 and larger.
5. Replaceable seats and plugs.
6. Furnish each control valve with a corrosion-resistant nameplate indicating the following:
  - a. Manufacturer's name, model number, and serial number.
  - b. Body and trim size.
  - c. Arrow indicating direction of flow.

B. Two-Way Globe Valves NPS 2 and Smaller:

1. Globe Style: Single port.
2. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: PTFE V-ring.
6. Plug: Top guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Range: 35 to 248 deg F.
9. Ambient Operating Temperature: 35 to 150 deg F.
10. Leakage: FCI 70-2, Class IV.
11. Rangeability: 25 to 1.
12. Equal percentage flow characteristic.

C. Three-Way Globe Valves NPS 2 and Smaller:

1. Globe Style: Mix flow pattern.
2. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: PTFE V-ring.
6. Plug: Top guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Range: 35 to 248 deg F.
9. Ambient Operating Temperature: 35 to 150 deg F.
10. Leakage: FCI 70-2, Class IV.
11. Rangeability: 25 to 1.
12. Linear flow characteristic.

D. Two-Way Globe Valves NPS 2-1/2 to NPS 6:

1. Globe Style: Single port.
2. Body: Cast iron complying with ASME B61.1, Class 125.
3. End Connections: Flanged, suitable for mating to ASME B16.5, Class 150 flanges.
4. Bonnet: Bolted.
5. Packing: PTFE cone-ring.
6. Plug: Top or bottom guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Rating: 35 to 281 deg F.
9. Leakage: 0.1 percent of maximum flow.
10. Rangeability: Varies with valve size between 6 and 10 to 1.

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11. Modified linear flow characteristic.

E. Three-Way Globe Valves NPS 2-1/2 to NPS 6:

1. Globe Style: Mix flow pattern.
2. Body: Cast iron complying with ASME B61.1, Class 125.
3. End Connections: Flanged suitable for mating to ASME B16.5, Class 150 flanges.
4. Bonnet: Bolted.
5. Packing: PTFE cone-ring.
6. Plug: Top or bottom guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Rating: 35 to 281 deg F.
9. Leakage: 0.1 percent of maximum flow.
10. Rangeability: Varies with valve size between 6 and 10 to 1.
11. Modified linear flow characteristic.

## 2.4 SOLENOID VALVES

A. Description:

1. Action: Either normally open or normally closed in the event of electrical power failure as required by the application.
2. Size to close against the system pressure.
3. Manual override capable.
4. Heavy-duty assembly.
5. Body: Brass or stainless steel.
6. Seats and Discs: NBR or PTFE.
7. Solenoid Enclosure: NEMA 250, Type 4.

## 2.5 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

- A. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.
- B. Position indicator and graduated scale on each actuator.
- C. Type: Motor operated, with or without gears, electric and electronic.
- D. Voltage: Voltage selection delegated to professional designing control system.
- E. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
- F. Function properly within a range of 85 to 120 percent of nameplate voltage.
- G. Field Adjustment:
1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.

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2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.
- H. Two-Position Actuators: Single direction, spring return type.
- I. Modulating Actuators:
1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
  2. Control Input Signal:
    - a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
    - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.
- J. Position Feedback:
1. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.
- K. Fail-Safe:
1. Where indicated, provide actuator to fail to an end position.
  2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
  3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.
- L. Integral Overload Protection:
1. Provide against overload throughout the entire operating range in both directions.
  2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.
- M. Valve Attachment:
1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
  2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
  3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.
- N. Temperature and Humidity:
1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.

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2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

O. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

P. Stroke Time:

1. Operate valve from fully closed to fully open within seconds.
2. Operate valve from fully open to fully closed within seconds.
3. Move valve to failed position within seconds.
4. Select operating speed to be compatible with equipment and system operation.

Q. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 CONTROL VALVE APPLICATIONS

A. Control Valves:

1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.

#### 3.3 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy most stringent requirements indicated.



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- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.
- D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.
- F. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for University's access, confirm unrestricted ladder placement is possible under occupied condition.

### 3.4 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

### 3.5 CONTROL VALVES

- A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.
- B. Install flanges or unions to allow drop-in and -out valve installation.
- C. Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 2.

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D. Valve Orientation:

1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
2. Install valves in a position to allow full stem movement.

E. Clearance:

1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

F. Threaded Valves:

1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

G. Flanged Valves:

1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.6 CONNECTIONS

- A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire and cable shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved nameplate with valve identification on valve and on face of ceiling directly below valves concealed above ceilings.

3.8 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

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- B. Wash and shine glazing.
- C. Polish glossy surfaces to a clean shine.

### 3.9 CHECKOUT PROCEDURES

- A. Control Valve Checkout:
  - 1. Check installed products before continuity tests, leak tests, and calibration.
  - 2. Check valves for proper location and accessibility.
  - 3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
  - 4. Verify that control valves are installed correctly for flow direction.
  - 5. Verify that valve body attachment is properly secured and sealed.
  - 6. Verify that valve actuator and linkage attachment are secure.
  - 7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
  - 8. Verify that valve ball, disc, and plug travel are unobstructed.
  - 9. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

### 3.10 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
- B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.
- C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
- D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION

## SECTION 230923.12 - CONTROL DAMPERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes the following types of control dampers and actuators for DDC systems:
  - 1. Rectangular control dampers.
  - 2. Round control dampers.
  - 3. General control-damper actuator requirements.
  - 4. Electric and electronic actuators.
- B. Related Requirements:
  - 1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 DEFINITIONS

- A. DDC: Direct-digital control.
- B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of the Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Product Data: For each type of product, including the following:
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical

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- power requirements, and limitations of ambient operating environment, including temperature and humidity.
- 3. Product description with complete technical data, performance curves, and product specification sheets.
- 4. Installation instructions, including factors affecting performance.

D. Shop Drawings:

- 1. Include plans, elevations, sections, and mounting details.
- 2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of the Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Product installation location shown in relationship to room, duct, and equipment.
  - 2. Size and location of wall access panels for control dampers and actuators installed behind walls.
  - 3. Size and location of ceiling access panels for control dampers and actuators installed above inaccessible ceilings.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of the Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For control dampers to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.
- C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

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- D. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.
- E. Selection Criteria:
  - 1. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
  - 2. Select modulating dampers for a pressure drop of 2 percent of fan total static pressure unless otherwise indicated.
  - 3. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.

## 2.2 RECTANGULAR CONTROL DAMPERS

- A. General Requirements:
  - 1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
  - 2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
  - 3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.
- B. Rectangular Dampers with Steel Airfoil Blades:
  - 1. Performance:
    - a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
    - b. Pressure Drop: 0.06-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
    - c. Velocity: Up to 6000 fpm.
    - d. Temperature: Minus 40 to plus 185 deg F.
    - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
    - f. Damper shall have AMCA seal for both air leakage and air performance.
  - 2. Construction:
    - a. Frame:
      - 1) Material: ASTM A 653/A 653M galvanized-steel profiles, 0.06 inch thick.
      - 2) Hat-shaped channel with integral flanges. Mating face shall be a minimum of 1 inch.
      - 3) Width not less than 5 inches.
    - b. Blades:
      - 1) Hollow, airfoil, galvanized steel.

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- 2) Parallel or opposed blade configuration as required by application.
- 3) Material: ASTM A 653/A 653M galvanized steel, 0.05 inch thick.
- 4) Width not to exceed 6 inches.
- 5) Length as required by close-off pressure, not to exceed 48 inches.

c. Seals:

- 1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
- 2) Jambs: Stainless steel, compression type.

d. Axles: 0.5-inch-diameter plated or stainless steel, mechanically attached to blades.

e. Bearings:

- 1) Stainless steel mounted in frame.
- 2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

- 1) Concealed in frame.
- 2) Constructed of aluminum and plated or stainless steel.
- 3) Hardware: Stainless steel.

g. Transition:

- 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
- 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
- 3) Damper size and sleeve shall be connection size plus 2 inches.
- 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
- 5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

- 1) Provide epoxy finish for surfaces in contact with airstream.
- 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

C. Insulated Rectangular Dampers:

1. Performance:

- a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure and shall not exceed 4.9 cfm/sq. ft. against 4-in. wg differential static pressure at minus 40 deg F.
- b. Pressure Drop: 0.1-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
- c. Velocity: Up to 4000 fpm.
- d. Temperature: Minus 100 to plus 185 deg F.

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- e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
  - f. Damper shall have AMCA seal for both air leakage and air performance.
2. Construction:
- a. Frame:
    - 1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles, 0.08 inch thick.
    - 2) C-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
    - 3) Width not less than 4 inches.
    - 4) Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.
    - 5) Damper frame shall be insulated with polystyrofoam on four sides.
  - b. Blades:
    - 1) Hollow shaped, extruded aluminum.
    - 2) Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
    - 3) Parallel or opposed blade configuration as required by application.
    - 4) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.08 inch thick.
    - 5) Width not to exceed 6 inches.
    - 6) Length as required by close-off pressure, not to exceed 48 inches.
  - c. Seals: Blade and frame seals shall be of flexible silicone and secured in an integral slot within the aluminum extrusions.
  - d. Axles: 0.44-inch-diameter plated or stainless steel, mechanically attached to blades.
  - e. Bearings:
    - 1) Bearings shall be composed of a Celcon inner bearing fixed to axle, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
    - 2) Where blade axles are installed in vertical position, provide thrust bearings.
  - f. Linkage:
    - 1) Concealed in frame.
    - 2) Constructed of aluminum and plated or stainless steel.
    - 3) Hardware: Stainless steel.
  - g. Transition:
    - 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
    - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
    - 3) Damper size and sleeve shall be connection size plus 2 inches.



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- 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
- 5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

- 1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
- 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

## 2.3 ROUND CONTROL DAMPERS

A. Round Dampers, Sleeve Type:

1. Performance:

- a. Leakage: Leakage shall not exceed 0.15 cfm/in. of perimeter blade at 4-in. wg differential static pressure.
- b. Pressure Drop: 0.02-in. wg at 1500 fpm across a 12-inch damper when tested according to AMCA 500-D, figure 5.3.
- c. Velocity: Up to 4000 fpm.
- d. Temperature: Minus 25 to plus 200 deg F.
- e. Pressure Rating: 8-in. wg for sizes through 12 inches, 6-in. wg for larger sizes.

2. Construction:

a. Frame:

- 1) Material: Galvanized steel, 0.04 in thick.
- 2) Outward rolled stiffener beads positioned approximately 1 inch inboard of each end.
- 3) Sleeve-type connection for mating to adjacent ductwork.
- 4) Size Range: 4 to 24 inches.
- 5) Length not less than 7 inches.
- 6) Provide 2-inch sheet metal stand-off for mounting actuator.

- b. Blade: Double-thickness circular flat blades sandwiched together and constructed of galvanized steel.
- c. Blade Seal: Polyethylene foam seal sandwiched between two sides of blades and fully encompassing blade edge.
- d. Axle: 0.5-inch-diameter plated or stainless steel, mechanically attached to blade.
- e. Bearings: Stainless-steel sleeve pressed into frame.

## 2.4 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

- A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

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- B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against one and a half (1.5) times the fan shutoff pressure as a minimum requirement.
- C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
- D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.
- E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.
- F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.
- G. Provide mounting hardware and linkages for connecting actuator to damper.
- H. Select actuators to fail in desired position in the event of a power failure.
- I. Actuator Fail Positions: As indicated below:
  - 1. Exhaust Air: Close.
  - 2. Outdoor Air: Close.
  - 3. Supply Air: Open.
  - 4. Return Air: Open.

## 2.5 ELECTRIC AND ELECTRONIC ACTUATORS

- A. Type: Motor operated, with or without gears, electric and electronic.
- B. Voltage:
  - 1. Voltage selection is delegated to professional designing control system.
  - 2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
  - 3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.
- C. Field Adjustment:
  - 1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
  - 2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.
- D. Two-Position Actuators: Single direction, spring return or reversing type.
- E. Modulating Actuators:

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1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
  2. Control Input Signal:
    - a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.
    - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.
- F. Fail-Safe:
1. Where indicated, provide actuator to fail to an end position.
  2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
  3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.
- G. Integral Overload Protection:
1. Provide against overload throughout the entire operating range in both directions.
  2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.
- H. Damper Attachment:
1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
  2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
  3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.
- I. Temperature and Humidity:
1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
  2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.
- J. Enclosure:
1. Suitable for ambient conditions encountered by application.
  2. NEMA 250, Type 2 for indoor and protected applications.
  3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
  4. Provide actuator enclosure with a heater and controller where required by application.
- K. Stroke Time:
1. Operate damper from fully closed to fully open within seconds.
  2. Operate damper from fully open to fully closed within seconds.

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3. Move damper to failed position within 10 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

L. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy most stringent requirements indicated.
- B. Properly support dampers and actuators, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.
- C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- D. Seal penetrations made in fire-rated and acoustically rated assemblies.
- E. Fastening Hardware:
  1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
  2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

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- F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

### 3.3 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

### 3.4 CONTROL DAMPERS

- A. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.
- B. Clearance:
  - 1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
  - 2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.
- C. Service Access:
  - 1. Dampers and actuators shall be accessible for visual inspection and service.
  - 2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."
- D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.
- E. Attach actuator(s) to damper drive shaft.
- F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

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3.5 CONNECTIONS

- A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire and cable shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."Section 16075 "Electrical Identification."
- B. Install engraved nameplate with damper identification on damper and on face of ceiling where damper is concealed above ceiling.

3.7 CHECKOUT PROCEDURES

- A. Control-Damper Checkout:
  - 1. Check installed products before continuity tests, leak tests, and calibration.
  - 2. Check dampers for proper location and accessibility.
  - 3. Verify that control dampers are installed correctly for flow direction.
  - 4. Verify that proper blade alignment, either parallel or opposed, has been provided.
  - 5. Verify that damper frame attachment is properly secured and sealed.
  - 6. Verify that damper actuator and linkage attachment are secure.
  - 7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
  - 8. Verify that damper blade travel is unobstructed.

3.8 ADJUSTMENT, CALIBRATION, AND TESTING:

- A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
- B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.
- C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
- D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION

## SECTION 230923.14 - FLOW INSTRUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Airflow sensors.
  - 2. Airflow transmitters.
  - 3. Liquid flow switches.

- B. Related Requirements:

- 1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 DEFINITIONS

- A. Ethernet: Local area network based on IEEE 802.3 standards.
- B. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.
- C. PEEK: polyetheretherketone.
- D. PTFE: Polytetrafluoroethylene.
- E. PPS: Polyphenylene sulfide.
- F. RS-485: A TIA standard for multipoint communications using two twisted pairs.
- G. RTD: Resistance temperature detector.
- H. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

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1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product, including the following. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 3. Product description with complete technical data, performance curves, and product specification sheets.
  - 4. Installation instructions, including factors affecting performance.
- C. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
  - 4. Include diagrams for air and process signal tubing.
  - 5. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Certificates: For each product requiring a certificate.
- C. Product Test Reports: For each product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.



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1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- C. Provide parts, as indicated by manufacturer's recommended parts list, for product operation during two-year period following warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 GENERAL REQUIREMENTS FOR FLOW INSTRUMENTS

- A. Air sensors and transmitters shall have an extended range of 20 percent above Project design flow and 20 percent below minimum Project flow to signal abnormal flow conditions and to provide flexibility for changes in operation.
- B. Liquid sensors, meters, and transmitters shall have an extended range of 20 percent above Project design flow and 10 percent below Project minimum flow to signal abnormal flow conditions and to provide flexibility for changes in operation.

2.3 AIRFLOW SENSORS:

- A. Performance Requirements:
  - 1. Adjustable for changes in system operational parameters.
  - 2. Airflow Sensor and Transmitter Range: Extended range of 20 percent above Project design flow and 20 percent below minimum Project flow to signal abnormal flow conditions.
  - 3. Manufacturer shall certify that each flow instrument indicated complies with specified performance requirements and characteristics.
    - a. Product certificates are required.
- B. Pitot-Tube Airflow Sensor Station:
  - 1. Description: Multiple total- and static-pressure sensors positioned at the center of equal area of the station cross section and interconnected by respective averaging manifolds.
    - a. Stations 4 sq. ft. and Smaller: One total-pressure sensor and one static-pressure sensor for every 16 sq. in. of station area.

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- b. Stations Larger than 4 sq. ft.: One total-pressure sensor and one static-pressure sensor for every 36 sq. in. of station area.
- 2. Casing: Galvanized sheet steel at least 0.079 inch thick with coating complying with ASTM A 653/A 653M, G90. Casings shall be stainless steel, 0.0781 inch thick, when connected to stainless duct and aluminum, 0.063 inch thick, when connected to aluminum duct.
  - a. Joints and Seams: Continuously weld. Clean galvanized areas damaged by welding and coat with aluminum paint.
  - b. Casing Depth: At least 8 inches.
  - c. Casing Flanges: Outward flange, minimum flange face 1.5 inches.
  - d. Casing Configuration and Size: Match shape (rectangular, round, flat oval) and same size as adjacent duct unless otherwise indicated.
- 3. Include an open parallel cell air straightener or air equalizer honeycomb mechanically fastened to casing.
  - a. Construct straightener or equalizer from Type 3003 aluminum or Type 316 stainless steel, depending on casing material. Use stainless steel for units with stainless-steel casings.
- 4. Construct pressure sensor array from drawn copper or stainless-steel tubing. Use stainless steel for units with stainless-steel casings. Copper tubing shall comply with ASTM B 75 and ASTM B 280. Minimum tube wall thickness shall be 0.030 inch. Include internal piping and external pressure transmitter ports.
- 5. Station Labeling: Identification label on each station casing indicating model number, size, area, and application-specific airflow range.
- 6. Performance:
  - a. Pressure Loss: 0.015-inch wg at 1000 fpm, or 0.085-inch wg at 2000 fpm.
  - b. Accuracy: Within 2 percent of actual airflow.
  - c. Self-Generated Sound: NC 40 and sound level within the duct shall not be amplified.
  - d. Performance rated and tested according to AMCA 610. Each station shall bear the AMCA seal.

C. Pitot-Tube Fan Inlet Airflow Traverse Sensor:

- 1. Traverse manifold designed for mounting in fan inlets.
- 2. Contain multiple total- and static-pressure sensors placed at concentric area centers along the exterior surface of cylindrical manifold and internally connected to their respective averaging manifolds. Sensors shall not protrude beyond the surface of the manifold nor be adversely affected by particle contamination present in airstream.
- 3. Manifold (two per inlet) shall have dual end support swivel brackets suitable for mounting in the fan inlet bell and symmetrical averaging signal takeoffs and fittings.
- 4. Sensors shall be capable of producing steady, non-pulsating signals of standard total- and static-pressure without need for flow corrections or factors, with an accuracy of 3 percent of actual flow over a turndown range of 6 to 1.
- 5. Manifold Materials: Copper or anodized aluminum or Type 316 stainless steel.
- 6. Unless otherwise required by application and without affecting the fan and sensor performance, nominal diameter copper and aluminum manifolds shall be the following:

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- a. For Fan Inlets Smaller than 20 Inches: 0.375 inch.
    - b. For Fan Inlets 20 Inches and Larger: 0.75 inch.
  7. Unless otherwise required by application and without affecting the fan and sensor performance, nominal diameter stainless-steel manifolds shall be the following:
    - a. For Fan Inlets Smaller than 20 Inches: 0.375 inch.
    - b. For Fan Inlets 20 through 48 Inches: 0.75 inch.
    - c. For Fan Inlets Larger than 48 Inches: 1.0 inch.
- D. Piezometer Ring Fan Inlet Airflow Sensor:
1. In lieu of externally mounted fan inlet airflow sensors, option to provide fans with airflow measurement integral to fan inlet cones for continuous measurement of air volume flow rate.
  2. Multiple pressure sensor points strategically placed along the circumference of the inlet cone and internally connected to an averaging ring manifold located behind the inlet cone.
  3. Sensor points shall not protrude beyond the surface of the inlet cone nor be adversely affected by particle contamination present in the airstream.
  4. Sensor shall produce steady, non-pulsating signals to achieve accuracy within 5 percent of actual airflow.
  5. Sensor shall be non-intrusive and not impact fan performance.
  6. Product shall be a standard offering of the fan manufacturer and include published literature with supporting test data to validate sensor performance.
- E. Thermal Airflow Station:
1. Source Limitations: Obtain airflow and temperature measuring sensors and transmitters from single manufacturer.
  2. Description: Airflow station shall consist of one or more sensor probes mounted in a casing, and a remotely mounted microprocessor-based transmitter.
  3. Performance:
    - a. Capable of independently processing up to 16 independently wired sensor assemblies.
    - b. Airflow rate of each sensor assembly shall be equally weighted and averaged by transmitter prior to output.
    - c. Temperature of each sensor assembly shall be velocity weighted and averaged by transmitter prior to output.
    - d. Listed and labeled by an NRTL as successfully tested as an assembly according to UL 873, "Temperature-Indicating and Regulating Equipment."
    - e. Components shall be interconnected by exposed NRTL-listed plenum-rated cable or non-listed cable placed in conduit.
    - f. Each flow station shall be factory calibrated at a minimum of 16 airflow rates and three temperatures to standards that are traceable to NIST.
    - g. Airflow Accuracy: Within 3 percent of reading over the entire operating airflow range.
- 1) Devices whose accuracy is combined accuracy of transmitter and sensor probes must demonstrate that total accuracy meets the performance requirements throughout the measurement range.

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- h. Temperature Accuracy: Within 0.2 deg F over entire operating range of minus 20 to plus 140 deg F.
  - i. Sensor Ambient Operating Temperature Range: Minus 20 to plus 160 deg F.
  - j. Transmitter Ambient Operating Temperature Range: Minus 20 to plus 120 deg F.
  - k. Sensor and Transmitter Ambient Operating Humidity Range: Zero to 99 percent, non-condensing.
  - l. Instrument shall compensate for changes in air temperature and density throughout calibrated velocity range for seasonal extremes at Project location.
  - m. Pressure Drop: 0.05-inch wg at 2000 fpm across a 24-by-24-inch area.
  - n. Instruments mounted in throat or face of fan inlet cone shall not negatively influence fan performance by reducing flow more than 1 percent of Project design flow or negatively impact fan-generated sound. Losses in performance shall be documented with submittal data, and adjustments to compensate for performance impact shall be made to fan in order to deliver Project design airflow indicated.
4. Sensor Assemblies:
- a. Each sensor probe shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
  - b. Mount thermistors in sensor using a marine-grade, waterproof epoxy.
  - c. Thermistor leads shall be protected and not exposed to the environment.
  - d. Each sensor assembly shall independently determine airflow rate and temperature at each measurement point.
  - e. Each sensor probe shall have an integral cable for connection to remotely mounted transmitter.
  - f. Sensor Probe Material: Gold anodized, extruded 6063 aluminum tube or Type 304 stainless steel.
  - g. Probe Assembly Mounting Brackets Material: Type 304 stainless steel.
5. Casing:
- a. Factory mount sensor probes in an airflow station casing to create a single assembly for field mounting.
  - b. Material: Galvanized sheet steel at least 0.079 inch thick with coating complying with ASTM A 653/A 653M, G90. Casings shall be stainless steel, 0.0781 inch thick, when connected to stainless duct and aluminum, 0.063 inch thick, when connected to aluminum duct.
  - c. Joints and Seams: Continuously weld. Clean galvanized areas damaged by welding and coat with zinc-rich paint.
  - d. Casing Depth: At least 8 inches.
  - e. Include casing inlet and discharge connections with a minimum 1.5-inch face flange.
6. Transmitter:
- a. Integral digital display capable of simultaneously displaying total airflow and average temperature, individual airflow, and temperature readings of each independent sensor assembly.
  - b. Capable of field configuration and diagnostics using an onboard push-button interface and digital display.

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- 1) Include an integral power switch to operate on 24-V ac (isolation not required) and include the following:
  - a) Integral protection from transients and power surges.
  - b) Circuitry to ensure reset after power disruption, transients, and brownouts.
  - c) Integral transformer to convert field power source to operating voltage required by instrument.

c. Remote Signal Interface:

- 1) Linear Analog Signals for Airflow and Temperature: Fuse protected and isolated, field selectable, zero- to 10-V dc or 4 to 20 mA.
- 2) RS-485: BACnet-ARCNET, BACnet-MS/TP, and Modbus-RTU.
- 3) 10 Base-T Ethernet: BACnet Ethernet, BACnet-IP, Modbus-TCP, and TCP/IP.
- 4) LonWorks free topology.

## 2.4 AIRFLOW TRANSMITTERS

A. Airflow Transmitter with 0.10 Percent Accuracy and Auto-Zero Feature:

1. Transmitter shall receive total- and static-pressure signals from a primary element, amplify signals, extract the square root, and scale the signals to produce 4- to 20-mA dc output signals linear to airflow.
2. NEMA 250, Type 1 enclosure.
3. Construct assembly so that shock, vibration, and pressures surges of up to 1 psig will neither harm transmitter, nor affect its accuracy.
4. Transmitter with automatic zeroing circuit capable of automatically readjusting transmitter zero at predetermined time intervals. The automatic zeroing circuit shall re-zero transmitter to within 0.1 percent of true zero.
5. Performance:
  - a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
  - b. Calibrated Span: Field adjustable, minus 40 percent of the range.
  - c. Accuracy: Within 0.10 percent of natural span.
  - d. Repeatability: Within 0.15 percent of calibrated span.
  - e. Linearity: Within 0.2 percent of calibrated span.
  - f. Hysteresis and Deadband (Combined): Less than 0.2 percent of calibrated span.
6. Integral digital LED or digital display for continuous indication of airflow.

B. Airflow Transmitters with 0.25 Percent Accuracy and Auto-Zero Feature:

1. Transmitter shall receive total- and static-pressure signals from a flow element, amplify signals, extract the square foot, and scale the signals to produce 4- to 20-mA dc output signals linear to airflow.
2. NEMA 250, Type 1 enclosure.
3. Construct assembly so shock, vibration, and pressures surges of up to 1 psig will neither harm transmitter, nor affect its accuracy.

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4. Transmitter with automatic zeroing circuit capable of automatically readjusting transmitter zero at predetermined time intervals. The automatic zeroing circuit shall re-zero the transmitter to within 0.1 percent of true zero.
  5. Performance:
    - a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
    - b. Calibrated Span: Field adjustable, minus 40 percent of the range.
    - c. Accuracy: Within 0.25 percent of natural span.
    - d. Repeatability: Within 0.15 percent of calibrated span.
    - e. Linearity: Within 0.2 percent of calibrated span.
    - f. Hysteresis and Deadband (Combined): Less than 0.2 percent of calibrated span.
  6. Integral digital display for continuous indication of airflow.
- C. Pressure Differential Transmitters for Airflow Measurement:
1. Performance:
    - a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
    - b. Accuracy: Within 1 percent of the full-scale range.
    - c. Hysteresis: Within 0.10 percent of full scale.
    - d. Repeatability: Within 0.05 percent of full scale.
    - e. Stability: Within one percent of span per year.
    - f. Overpressure: 10 psig.
    - g. Temperature Limits: Zero to 150 deg F.
    - h. Compensate Temperature Limits: 40 to 150 deg F.
    - i. Thermal Effects: 0.033 percent of full scale per degree F.
    - j. Shock and vibration shall not harm the transmitter.
  2. Output Signals:
    - a. Analog Current Signal:
      - 1) Two-wire, 4- to 20-mA dc current source.
      - 2) Signal capable of operating into 800-ohm load.
    - b. Analog Voltage Signal:
      - 1) Three wire, zero to 10 V.
      - 2) Minimum Load Resistance: 1000 ohms.
  3. Display: Four-digit digital with minimum 0.4-inch-high numeric characters.
  4. Operator Interface:
    - a. Zero and span adjustments located behind cover.
  5. Construction:
    - a. Plastic casing with removable plastic cover.

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- b. Fittings: Swivel fittings for connection to copper tubing or barbed fittings for connection to polyethylene tubing. Fittings on bottom of instrument case.
- c. Screw terminal block for wire connections.
- d. Vertical plane mounting.
- e. NEMA 250, Type 4.
- f. Mounting Bracket: Appropriate for installation.

D. Pressure Differential Indicating Transmitter, Switch, and Controller for Airflow Measurement:

1. Description:

- a. Three-in-one instrument, including digital display, control relay switches, and a transmitter with a current output.
- b. Field configurable for pressure, velocity, and volumetric flow applications through user interface.
- c. Select instrument range based on application.

2. Performance:

- a. Accuracy including hysteresis and repeatability:
  - 1) Ranges Less than 5-Inch wg: Within 1 percent.
  - 2) Other Ranges: Within 0.5 percent at 77 deg F.

- b. Stability: Within 1 percent per year.
- c. Response Time: 250 ms.
- d. Overpressure:
  - 1) Ranges Less than 50-Inch wg: 5 psi
  - 2) Range of 100-Inch wg: 9 psi.
- e. Temperature Limits: 32 to 140 deg F.
- f. Thermal Effects: 0.020 percent per deg F.
- g. Warm-up Period: One hour.

3. Controller: Programming through menu keys to access five menus.

- a. Security level.
- b. Pressure, velocity, or flow application.
- c. Engineering units.
- d. K-factor for use with flow application.
- e. Set-point control only; set-point and alarm operation; alarm operation as high, low, or high/low with manual; or automatic reset and delay.
- f. View high and low readings.
- g. Digital dampening for smoothing erratic applications.
- h. Scaling of analog output to fit range and field calibration.

4. Display:

- a. Four-digit digital, with minimum 0.4-inch-high alphanumeric characters.
- b. Four LED indicators; two LEDs for set point and two LEDs for alarm status.

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5. Operator Interface:
  - a. Set-point adjustment through keypad on face of instrument.
  - b. Zero and span adjustments accessible through menu.
  - c. Programming through keypad.
6. Output Analog Signal: Two-wire, 4- to 20-mA dc current source; capable of operating into a 900-ohm load.
7. Output Digital Signal: Two, SPDT relays; each rated for 1 A at 30-V ac or 30-V dc.
8. Construction:
  - a. Die-cast aluminum casing and bezel.
  - b. Connections on side and back.
  - c. Vertical plane mounting.
  - d. NEMA 250, Type 1 rating.
  - e. Nominal 4-inch-diameter face.
  - f. Mounting Bracket: Appropriate for installation.

## 2.5 LIQUID FLOW SWITCHES

### A. Liquid Flow Switch (Magnetic Type):

1. Description:
  - a. Field-adjustable five-vane combinations.
  - b. Suitable for pipe sizes NPS 1-1/2 through NPS 20.
  - c. Mounting Suitable for Application: Switch vertically mounted in horizontal pipe, or switch horizontally mounted in vertical pipe with flow up.
  - d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for hazardous-environment Class I, Groups C and D; Class II, Groups E, F, and G.
2. Performance:
  - a. Flow Rate Actuation and De-actuation: Varies with vane combination.
  - b. Pressure Limit: 1000 psig for brass body, 2000 psig for Type 316 stainless-steel body.
  - c. Temperature Range: Minus 4 to plus 275 deg F.
  - d. Electrical Rating: 10 A at 125/250-V ac.
3. Wetted Parts Construction:
  - a. Vanes: Type 316 stainless steel.
  - b. Body: Brass.
  - c. Magnetic Keeper: Type 316 or 430 stainless steel.
  - d. Process Connection: NPS 1-1/2.
4. Enclosure:
  - a. Die-cast aluminum alloy.
  - b. Threaded cover.



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- c. NEMA 250, Type 4.
- d. Electrical Connection: Terminal block.
- e. Conduit Connection: trade size.

B. Liquid Flow Switch (Magnetic Type) for Small-Diameter Pipe:

1. Description:

- a. Suitable for pipe sizes NPS 1/2 through NPS 2.
- b. Mounting Suitable for Application: Switch vertically mounted in horizontal pipe, or switch horizontally mounted in vertical pipe with flow up.
- c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for hazardous-environment Class I, Groups A, B, C, and D; Class II, Groups E, F, and G.

2. Performance:

- a. Flow Rate Actuation and De-actuation: Not adjustable.
- b. Pressure Limit of Body: 1000 psig for brass, 2000 psig for Type 303 stainless-steel body.
- c. Pressure Limit of Tee: 250 psig for brass, 1000 psig for malleable iron, and 2000 psig for forged carbon steel and stainless steel.
- d. Temperature Range: Minus 4 to plus 220 deg F.
- e. Electrical Rating: 5 A at 125/250-V ac.

3. Wetted Parts Construction (Lower Body):

- a. Vanes: Type 301 stainless steel.
- b. Body: Brass.
- c. Magnet: Ceramic.
- d. Process Connection: NPS 1/2.

4. Enclosure (Upper Body):

- a. Brass.
- b. NEMA 250, Type 4.
- c. Electrical Connection: Terminal block.
- d. Conduit Connection: 3/4-inch trade size.

5. Integral Mounting Tee Furnished with Switch:

- a. Brass.
- b. Size: Match adjacent pipe.
- c. Connection: Threaded pipe.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTRUMENT APPLICATIONS

- A. Select from instrument types to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
- B. Duct-Mounted Airflow Sensors:
  - 1. Measured Velocities 500 fpm and Less: Thermal airflow station.
  - 2. Measured Velocities Greater than 500 fpm: Pitot-tube airflow sensor station or thermal airflow station.

3.3 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy more stringent of all requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.
- D. Install ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- E. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.4 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.

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- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

### 3.5 INSTRUMENTS, GENERAL INSTALLATION REQUIREMENTS

#### A. Mounting Location:

- 1. Rough-in: Outline instrument-mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
- 2. Install switches and transmitters for air and liquid flow associated with individual air-handling units and connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
- 3. Install liquid flow switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
- 4. Install airflow switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
- 5. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
- 6. Install instruments in liquid and liquid-sealed-piped services below their process connection point. Slope tubing down to instrument with a slope of 2 percent.

### 3.6 FLOW INSTRUMENTS INSTALLATION

#### A. Airflow Sensors:

- 1. Install sensors in straight sections of duct with manufacturer-recommended straight duct upstream and downstream of sensor.
- 2. Installed sensors shall be accessible for visual inspection and service. Install access door(s) in duct or equipment located upstream of sensor, to allow service personnel to hand clean sensors.

#### B. Liquid and Steam Sensors:

- 1. Install sensors in straight sections of piping with manufacturer-recommended straight piping upstream and downstream of sensor.
- 2. Alert manufacturer where installation cannot accommodate recommended clearance, and solicit recommendations for field modifications to installation, such as flow straighteners, to improve condition.
- 3. Install pipe reducers for in-line sensors smaller than line size. Position reducers at distance from sensor to avoid interference and impact on accuracy.

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4. Install in-line sensors with flanges or unions to provide drop-in and -out installation.

C. Liquid Flow Meters:

1. Install meters in straight sections of piping with manufacturer-recommended straight piping upstream and downstream of sensor.
2. Install pipe reducers for in-line meters smaller than line size. Install reducers at distance from meter to avoid interference and impact on accuracy.
3. Install in-line meters with flanges or unions to provide drop-in and -out installation.
4. Insertion Meters:
  - a. Install meter in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement.
  - b. In applications where top-dead-center location is not possible due to field constraints, install meter at location along top half of pipe if acceptable by manufacturer for mounting orientation.

D. Liquid Switches:

1. Install switch in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement.
2. In applications where top-dead-center location is not possible due to field constraints, install switch at location along top half of pipe if switch is acceptable by manufacturer for mounting orientation.

E. Transmitters:

1. Install airflow transmitters serving an air system in a single location adjacent to or within system control panel.
2. Install liquid flow transmitters, not integral to sensors, in vicinity of sensor. Where multiple flow transmitters serving same system are located in same room, co-locate transmitters by system to provide service personnel a single and convenient location for inspection and service.

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with instrument identification.

### 3.8 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.
- B. Wash and shine glazing.

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- C. Polish glossy surfaces to a clean shine.

### 3.9 CHECKOUT PROCEDURES

- A. Description:

1. Check out installed products before continuity tests, leak tests, and calibration.
2. Check instruments for proper location and accessibility.
3. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.

- B. Flow Instrument Checkout:

1. Verify that sensors are installed correctly with respect to flow direction.
2. Verify that sensor attachment is properly secured and sealed.
3. Verify that processing tubing attachment is secure and isolation valves have been provided.
4. Inspect instrument tag against approved submittal.
5. Verify that recommended upstream and downstream distances have been maintained.

### 3.10 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after-calibration-indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

- B. Analog Signals:

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1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.11 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 24 months' full maintenance by manufacturer's authorized service representative. Include annual preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.12 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.
- B. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.
- C. Record videos on DVD disks.
- D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION

## SECTION 230923.16 - GAS INSTRUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes the Following Gas Instruments:
  - 1. Carbon-dioxide sensors and transmitters.
- B. Related Requirements:
  - 1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 DEFINITIONS

- A. NDIR: Nondispersive infrared.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Product Data: For each type of product, including the following:
  - 1. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 2. Installation instructions, including factor affecting performance.
  - 3. Product description with complete technical data, performance curves, product specification sheets.
- D. Shop Drawings:

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1. Include plans, elevations, sections, and mounting details.
2. Include diagrams for power, signal, and control wiring.
3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which wall-mounted instruments located in finished space are shown and coordinated with each other, showing relationship to light switches, fire alarm devices, and other installed devices using input from installers of the items involved.
- C. Product Test Reports: For each product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Operation and Maintenance Data: For gas instruments to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 CARBON-DIOXIDE SENSORS AND TRANSMITTERS

- A. Description:
  1. NDIR technology or equivalent technology providing long-term stability and reliability.
  2. Two-wire, 4-20 mA output signal, linearized to carbon-dioxide concentration in ppm.
- B. Construction:
  1. House electronics in an ABS plastic enclosure. Provide equivalent of NEMA 250, Type 1 enclosure for wall-mounted space applications and NEMA 250, Type 4 for duct-mounted applications.
  2. Equip with digital display for continuous indication of carbon-dioxide concentration.
- C. Performance:
  1. Measurement Range: Zero to 2000 ppm.



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2. Accuracy: Within 2 percent of reading, plus or minus 30 ppm.
3. Repeatability: Within 1 percent of full scale.
4. Temperature Dependence: Within 0.05 percent of full scale over an operating range of 25 to 110 deg F.
5. Long-Term Stability: Within 5 percent of full scale after more than five years.
6. Response Time: Within 60 seconds.
7. Warm-up Time: Within five minutes.

- D. Provide calibration kit. Turn over to Owner at start of warranty period.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy more stringent of all requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Fastening Hardware:
  1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by using excessive force or oversized wrenches.
  3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

#### 3.3 ELECTRICAL POWER

- A. Furnish and install electrical power to products requiring electrical connections.

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- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 INSTRUMENTS, GENERAL INSTALLATION REQUIREMENTS

- A. Mounting Height:
  - 1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
- B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated, using neoprene gaskets or grommets.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved nameplate with instrument identification on face.

3.6 CHECKOUT PROCEDURES

- A. Check out installed products before continuity tests, leak tests, and calibration.
- B. Check instruments for proper location and accessibility.
- C. Check instruments for proper installation on elevation, orientation, insertion depth, or other applicable considerations that impact performance.
- D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.

3.7 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:
  - 1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

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2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, perform a three-point calibration test for both linearity and accuracy.
4. Equipment and procedures used for calibration shall comply with instrument manufacturer's written recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have an accuracy of at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If, after calibration, indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures in ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

### 3.8 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

END OF SECTION

SECTION 230923.19 - MOISTURE INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes moisture switches, sensors, and transmitters.
- B. Related Requirements:
  - 1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Product Data: For each type of product, including the following:
  - 1. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 2. Product description with complete technical data, performance curves, and product specification sheets.
- D. Shop Drawings:
  - 1. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Include diagrams for power, signal, and control wiring.
  - 3. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

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1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Operation and Maintenance Data: To include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MOISTURE SENSORS AND TRANSMITTERS

- A. Sensor and Transmitter without Display:
  - 1. Performance:
    - a. Accuracy including non-linearity, hysteresis, and repeatability: Within 2 percent from zero to 90 percent relative humidity and within 3 percent from 90 to 95 percent relative humidity when operating at 68 deg F.
    - b. Relative Humidity Range:
      - 1) Duct: Zero to 100 percent.
      - 2) Space: Zero to 95 percent relative.
    - c. Factory calibrated and NIST traceable with certificate included.
  - 2. Construction for Space Applications:
    - a. Housing with integral sensor.
    - b. Housing shall be ABS plastic or powder-coated aluminum.
    - c. Enclosure: NEMA 250, Type 4.
    - d. Provide housing with a wall-mounting plate.
  - 3. Construction for Duct and Equipment Applications:
    - a. Housing with integral sensor.
    - b. Duct Sensor Body: 300 series stainless steel.
    - c. Provide sensor with sintered stainless-steel filter for duct applications.
    - d. Housing shall be cast aluminum.
    - e. Enclosure: NEMA 250, Type 4.
  - 4. Output Signal: Two-wire, 4- to 20-mA output signal with drive capacity of at least 500 ohms at 24-V dc.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.
- C. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
- D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

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3.4 MOISTURE INSTRUMENTS INSTALLATION

- A. Mounting Location: Rough-in instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.
- B. Mounting Height:
  - 1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
  - 2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code, state, and Federal accessibility requirements within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.
    - a. Make every effort to mount at 60 inches.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section "Identification for Electrical Systems."
- B. Install engraved nameplate with instrument identification on face of ceiling directly below instruments concealed above ceilings.

3.6 CHECKOUT PROCEDURES

- A. Check installed products before continuity tests and calibration.
- B. Check instruments for proper location and accessibility.
- C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

3.7 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:
  - 1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
  - 2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
  - 3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
  - 4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
  - 5. Provide diagnostic and test equipment for calibration and adjustment.

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6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

END OF SECTION



## SECTION 230923.23 - PRESSURE INSTRUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Air-pressure sensors.
2. Air-pressure switches.
3. Air-pressure transmitters.
4. Liquid-pressure switches.
5. Liquid-pressure transmitters.

- B. Related Requirements:

1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 DEFINITIONS

- A. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a control, asset management, safety, or other system using any control platform.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of the Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Product Data: For each type of product, including the following:
  1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

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2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

D. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of the Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Product installation location shown in relationship to room, duct, pipe, and equipment.
  2. Wall-mounted instruments located in finished space, showing relationship to light switches, fire alarm devices, and other installed devices.
  3. Size and location of wall access panels for instruments installed behind walls.
  4. Size and location of ceiling access panels for instruments installed in accessible ceilings.
- C. Product Certificates: For each product requiring a certificate.
- D. Product Test Reports: For each product requiring test performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- E. Source quality-control reports.
- F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of the Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

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- C. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
  - a. If instrument alone cannot comply with requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, filtered, and ventilated as required by instrument and application.

2.2 AIR-PRESSURE SENSORS

A. Duct Traverse Static Pressure Sensor:

1. Sensor shall traverse the duct cross section and have at least one pickup point every 6 inches along length of sensor.
2. Construct sensor of 18-gage Type T6063-T5 extruded and anodized aluminum.
3. Sensor supported with threaded rod, sealing washer, and nut at one end and a mounting plate with gasket at other end.
4. Mounting plate with threaded, NPS 3/8 compression fitting for connection to tubing.
5. Accuracy within 1 percent of actual operating static pressure.
6. Dual offset static sensor design shall provide accurate sensing of duct static pressure in the presence of turbulent and rotational airflows with a maximum 30 degree yaw and pitch.
7. Suitable for velocities of 100 to 10000 fpm and temperatures of up to 200 deg F.
8. Sensor air resistance shall be less than 0.1 times the velocity pressure at probe-operating velocity.
9. Suitable for flat oval, rectangular, and round duct configurations.

B. Outdoor Static Pressure Sensor:

1. Sensor with no moving parts.
2. Operation not affected and impaired by rain and snow.
3. Sensing plates constructed of 0.1406-inch Type 316 stainless steel.
4. Accuracy within:
  - a. 1 percent of the actual outdoor atmospheric pressure when subjected to varying horizontal radial wind velocities up to 40 mph.
  - b. 2 percent of the actual outdoor atmospheric pressure while subjected to varying radial wind velocities up to 40 mph with approach angles up to 30 degrees to horizontal.

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- c. 3 percent of the actual outdoor atmospheric pressure while subjected to varying radial wind velocities up to 40 mph with approach angles up to 60 degrees to horizontal.
- d. Threaded, NPS 2 connection.

C. Space Static Pressure Sensor for Wall Mounting:

- 1. Stainless-steel wall plate with perforated center arranged to sense space static pressure. Exposed surfaces are provided with brush finish.
- 2. Wall plate provided with screws and sized to fit standard single-gang electrical box.
- 3. Back of sensor plate fitted with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, and 0.125-inch fitting for tubing connection.
- 4. Performance: Within 1 percent of actual room static pressure in vicinity of sensor while being subjected to an air velocity of 1000 fpm from a 360-degree radial source.

D. Space Static Pressure Sensor for Recessed Ceiling Mounting:

- 1. Stainless-steel round plate with perforated center arranged to sense space static pressure. Exposed surfaces provided with brush finish.
- 2. Sensor intended for flush mount on face of ceiling with pressure chamber recessed in ceiling plenum.
- 3. Back of sensor plate fitted with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, and 0.125-inch fitting for concealed tubing connection.
- 4. Performance: Within 1 percent of actual room static pressure in vicinity of sensor while being subjected to an air velocity of 1000 fpm from a 360-degree radial source.

2.3 AIR-PRESSURE SWITCHES

A. Air-Pressure Differential Switch with Set-Point Indicator:

- 1. Diaphragm operated to actuate an SPDT snap switch.
- 2. Electrical Connections: Three-screw configuration, including one screw for common operation and two screws for field-selectable normally open or closed operation.
- 3. Enclosure Conduit Connection: Knock out or threaded connection.
- 4. User Interface: Screw-type set-point adjustment with enclosed set-point indicator and scale.
- 5. High and Low Process Connections: Threaded, NPS 1/8.
- 6. Enclosure:
  - a. Dry Indoor Installations: NEMA 250, Type 1.
  - b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
  - c. Hazardous Environments: Explosion proof.
- 7. Operating Data:
  - a. Electrical Rating: 15 A at 120- to 480-V ac.
  - b. Pressure Limits:
    - 1) Continuous: 10 psig.
    - 2) Surge: 25 psig.

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- c. Temperature Limits: Minus 30 to 110 deg F.
- d. Operating Range: Approximately 2 times set point.
- e. Repeatability: Within 1 percent.
- f. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Air-Pressure Differential Indicating Switch:

- 1. Combination gage with low- and high-limit switches.
- 2. Nominal 4-inch-diameter analog indication with white dial face, graduated black markings, pointer to indicate measured value, and a separate adjustable pointer for each switch set point.
- 3. Switch zero and set-point adjustment screws or knobs on the dial face.
- 4. Each switch used as a safety limit shall have a manual reset button local to switch.
- 5. Switch Type: Each set point shall have two Form C relays, DPDT.
- 6. Electrical Connections: Screw terminals.
- 7. Enclosure Conduit Connection: NPS 3/4 threaded connection.
- 8. High and Low Process Connections: Threaded, NPS 1/8.
- 9. Enclosure:
  - a. Dry Indoor Installations: NEMA 250, Type 1.
  - b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
  - c. Hazardous Environments: Explosion proof.

10. Operating Data:

- a. Electrical Rating: 10 A at 120- to 240-V ac.
- b. Pressure Limits: 25 psig.
- c. Temperature Limits: 20 to 120 deg F.
- d. Operating Range: Approximately twice normal operating range unless otherwise required for application.
- e. Accuracy:
  - 1) 4 percent for ranges through 0.5 in. wg.
  - 2) 2 percent for ranges 1 in. wg and greater.
- f. Repeatability: Within 1 percent of full scale.
- g. Switch Deadband: One pointer width and within 1 percent of full scale for each switch set point.
- h. Power Supply: 24 or 120-V ac, 50/60 Hz.
- i. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 AIR-PRESSURE TRANSMITTERS

A. Air-Pressure Differential Transmitter:

- 1. Performance:
  - a. Range: Approximately 2 times set point.
  - b. Accuracy: Within 0.5 percent of the full-scale range.

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- c. Hysteresis: Within 0.10 percent of full scale.
  - d. Repeatability: Within 0.05 percent of full scale.
  - e. Stability: Within 1 percent of span per year.
  - f. Overpressure: 10 psig.
  - g. Temperature Limits: Zero to 150 deg F.
  - h. Compensate Temperature Limits: 40 to 150 deg F.
  - i. Thermal Effects: 0.033 percent of full scale per degree F.
  - j. Shock and vibration shall not harm the transmitter.
- 2. Output Signals:
  - a. Analog Current Signal:
    - 1) Two-wire, 4- to 20-mA dc current source.
    - 2) Signal capable of operating into 800-ohm load.
  - b. Analog Voltage Signal:
    - 1) Three wire, zero to 5 or 10 V.
    - 2) Minimum Load Resistance: 1000 ohms.
- 3. Display: Four-digit digital display with minimum 0.4-inch-high numeric characters.
- 4. Operator Interface: Zero and span adjustments located behind cover.
- 5. Construction:
  - a. Plastic casing with removable plastic cover.
  - b. Threaded, NPS 1/4 swivel fittings for connection to copper tubing or NPS 3/16 barbed fittings for connection to polyethylene tubing. Fittings on bottom of instrument case.
  - c. Screw terminal block for wire connections.
  - d. Vertical plane mounting.
  - e. NEMA 250, Type 4.
  - f. Provide mounting bracket suitable for installation.

## 2.5 LIQUID-PRESSURE SWITCHES

### A. Liquid-Pressure Differential Switch with Set-Point Indicator:

- 1. Description:
  - a. Brass or Type 316 stainless-steel double opposing bellows operate to actuate a SPDT snap switch.
  - b. Electrical Connections: Screw terminal.
  - c. Enclosure Conduit Connection: Knock out or threaded connection.
  - d. User Interface: Thumbscrew set-point adjustment with enclosed set-point indicator and scale.
  - e. High and Low Process Connections: Threaded, NPS 1/8.
  - f. Enclosure:
    - 1) Dry Indoor Installations: NEMA 250, Type 1.
    - 2) Outdoor and Wet Indoor Installations: NEMA 250, Type 4.

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3) Hazardous Environments: Explosion proof.

g. Operating Data:

- 1) Electrical Rating: 15 A at 120- to 240-V ac.
- 2) Pressure Limits: At least 5 times full-scale range, but not less than system design pressure rating.
- 3) Temperature Limits: Minus 10 to 180 deg F.
- 4) Operating Range: Approximately 2 times set point.
- 5) Deadband: Fixed.

## 2.6 LIQUID-PRESSURE TRANSMITTERS

A. Liquid-Pressure Differential Transmitter:

1. Performance:

- a. Range: Approximately 2 times the set point.
- b. Span: Adjustable plus or minus one milliamp, noninteractive.
- c. Accuracy: Within 0.25 percent of full scale.
- d. Hysteresis: Within 0.1 percent of full scale.
- e. Repeatability: Within 0.05 percent of full scale.
- f. Maximum Working Pressure: 250 psig.
- g. Temperature Limits: Zero to 175 deg F.
- h. Compensate Temperature Limits: 30 to 150 deg F.
- i. Thermal Effects: 0.02 percent of full scale per degree F.
- j. Response Time: 30 to 50 ms.
- k. Shock and vibration shall not harm the transmitter.

2. Analog Output Current Signal:

- a. Two-wire, 4- to 20-mA dc current source.
- b. Signal capable of operating into 1000-ohm load.

3. Analog Output Voltage Signal:

- a. Three wire, zero to 5 or 10 V or 2 to 10 V.
- b. Minimum Load Resistance: 1000 ohms.

4. Operator Interface:

- a. Zero and span adjustments located behind cover.
- b. Bleed screws on side of body, two screws on low-pressure side, and one screw on high-pressure side, for air in line and pressure cavity.

5. Construction:

- a. Aluminum and stainless-steel enclosure with removable cover.
- b. Wetted parts of transmitter constructed of 17-4 PH or 300 Series stainless steel.
- c. Threaded, NPS 1/4 process connections on side of instrument enclosure.

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- d. Knock out for 1/2-inch nominal conduit connection on side of instrument enclosure.
  - e. Screw terminal block for wire connections.
  - f. NEMA 250, Type 4.
  - g. Mounting Bracket: Appropriate for installation.
6. Provide transmitter with three-valve manifold. Construct manifold of brass, bronze, or stainless steel. Provide manifold with NPS 1/4 NPT process connections.

2.7 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled pressure instruments, as indicated by instrument requirements. Affix standards organization's certification and label.
- B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement, sway, or a break in attachment when subjected to a force.
- C. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- D. Fastening Hardware:



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1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by using excessive force or oversized wrenches.
- E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

### 3.3 ELECTRICAL POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

### 3.4 PRESSURE INSTRUMENT INSTALLATION

- A. Mounting Location:
  1. Rough-in: Outline instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.
  2. Install switches and transmitters for air and liquid pressure associated with individual air-handling units and associated connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
  3. Install liquid pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
  4. Install air-pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
  5. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
  6. Install instruments (except pressure gages) in liquid and liquid-sealed piped services below their process connection point. Slope tubing down to instrument with a slope of 2 percent.
  7. Install instruments in dry gas and noncondensable vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 2 percent.

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- B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.
- C. Duct Pressure Sensors:
  - 1. Install sensors using manufacturer's recommended upstream and downstream distances.
  - 2. Unless indicated on Drawings, locate sensors approximately 67 percent of distance of longest duct pressure drop run. Location of sensors shall be submitted and approved before installation.
  - 3. Install mounting hardware and gaskets to make sensor installation airtight.
  - 4. Route tubing from the sensor to transmitter.
  - 5. Use compression fittings at terminations.
  - 6. Install sensor in accordance with manufacturer's instructions.
  - 7. Support sensor to withstand maximum air velocity, turbulence, and vibration encountered to prevent instrument failure.
- D. Outdoor Pressure Sensors:
  - 1. Install roof-mounted sensor in least-noticeable location and as far away from exterior walls as possible.
  - 2. Locate wall-mounted sensor in an inconspicuous location.
  - 3. Submit sensor location for approval before installation.
  - 4. Verify signal from sensor is stable and consistent to all connected transmitters. Modify installation to achieve proper signal.
  - 5. Route outdoor signal pipe full size of sensor connection to transmitters. Install branch connection of size required to match to transmitter.
  - 6. Install sensor signal pipe with dirt leg and drain valve below roof penetration.
  - 7. Insulate signal pipe with flexible elastomeric insulation as required to prevent condensation.
  - 8. Connect roof-mounted signal pipe exposed to outdoors to building grounding system.
- E. Air-Pressure Differential Switches:
  - 1. Install air-pressure sensor in system for each switch connection. Install sensor in an accessible location for inspection and replacement.
  - 2. A single sensor may be used to share a common signal to multiple pressure instruments.
  - 3. Install access door in duct and equipment to access sensors that cannot be inspected and replaced from outside.
  - 4. Route NPS 3/8 tubing from sensor to switch connection.
  - 5. Do not mount switches on rotating equipment.
  - 6. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
  - 7. Install switches in an easily accessible location serviceable from floor.
  - 8. Install switches adjacent to system control panel if within 50 feet; otherwise, locate switch in vicinity of system connection.
- F. Liquid-Pressure Differential Switches:
  - 1. Where process connections are located in mechanical equipment room, install switch in convenient and accessible location near system control panel.

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2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate switch near system control panel.
3. Where multiple switches serving same system are installed in same room, install switches by system to provide service personnel a single and convenient location for inspection and service.
4. System process tubing connection shall be full size of switch connection, but not less than NPS 1/2. Install bushing if required to mate switch to system connection.
5. Connect process tubing from point of system connection and extend to switch.
6. Install isolation valves in process tubing as close to system connection as practical.
7. Install dirt leg and drain valve at each switch connection.
8. Do not mount switches on rotating equipment.
9. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
10. Install switches in an easily accessible location serviceable from floor.

G. Liquid-Pressure Transmitters:

1. Where process connections are installed in mechanical equipment room, install transmitter in convenient and accessible location near system control panel.
2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate transmitter near system control panel.
3. Where multiple transmitters serving same system are installed in same room, install transmitters by system to provide service personnel a single and convenient location for inspection and service.
4. System process tubing connection shall be full size of switch connection, but not less than NPS 1/2. Install bushing if required to mate switch to system connection.
5. Connect process tubing from point of system connection and extend to transmitter.
6. Install isolation valves in process tubing as close to system connection as practical.
7. Install dirt leg and drain valve at each transmitter connection.
8. Do not mount transmitters on equipment.
9. Install in a location free from vibration, heat, moisture, or adverse effects, which could damage and hinder accurate operation.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

3.6 CHECKOUT PROCEDURES

- A. Check out installed products before continuity tests, leak tests, and calibration.
- B. Check instruments for proper location and accessibility.

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- C. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

### 3.7 ADJUSTMENT, CALIBRATION, AND TESTING

#### A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, perform a three-point calibration test for both linearity and accuracy.
4. Equipment and procedures used for calibration shall comply with instrument manufacturer's recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If, after calibration, indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

#### B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.

#### C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

#### D. Sensors: Check sensors at zero, 50, and 100 percent of project design values.

#### E. Switches: Calibrate switches to make or break contact at set points indicated.

#### F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of project design values.

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3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

END OF SECTION

## SECTION 230923.27 - TEMPERATURE INSTRUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Air temperature sensors.
  - 2. Air temperature switches.
  - 3. Air temperature RTD transmitters.
  - 4. Liquid temperature sensors.
  - 5. Liquid temperature switches.

- B. Related Requirements:

- 1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 DEFINITIONS

- A. HART (Highway Addressable Remote Transducer) Protocol: The global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bidirectional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from a technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.
- B. RTD: Resistance temperature detector.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Product Data: For each type of product, including the following:

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1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation operation and maintenance instructions, including factors affecting performance.

D. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Product installation location shown in relationship to room, duct, pipe, and equipment.
  2. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
  3. Sizes and locations of wall access panels for instruments installed behind walls.
  4. Sizes and locations of ceiling access panels for instruments installed in inaccessible ceilings.
- C. Product Certificates: For each product requiring a certificate.
- D. Product Test Reports: For each product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- E. Field quality-control reports.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- C. Provide two matching product(s) in Project inventory for each unique size and type of temperature instrument provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

- 1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
  - a. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, filtered, and ventilated as required by instrument and application.

2.2 AIR TEMPERATURE SENSORS

A. Platinum RTDs: Common Requirements:

- 1. 100 or 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
- 2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
- 3. Performance Characteristics:
  - a. Range: Minus 50 to 275 deg F.
  - b. Interchangeable Accuracy: At 32 deg F within 0.5 deg F.
  - c. Repeatability: Within 0.5 deg F.
  - d. Self-Heating: Negligible.
- 4. Transmitter Requirements:
  - a. Transmitter required for each 100-ohm RTD.
  - b. Transmitter optional for 1000-ohm RTD, contingent on compliance with end-to-end control accuracy.

B. Platinum RTD, Single-Point Air Temperature Duct Sensors:

- 1. 100 or 1000 ohms.
- 2. Temperature Range: Minus 50 to 275 deg F
- 3. Probe: Single-point sensor with a stainless-steel sheath.
- 4. Length: As required by application to achieve tip at midpoint of air tunnel, up to 18 inches.



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5. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
6. Gasket for attachment to duct or equipment to seal penetration airtight.
7. Conduit Connection: 1/2-inch

C. Platinum RTD, Air Temperature Averaging Sensors:

1. 100 or 1000 ohms.
2. Temperature Range: Minus 50 to 275 deg F
3. Multiple sensors to provide average temperature across entire length of sensor.
4. Rigid probe of aluminum, brass, copper, or stainless-steel sheath.
5. Flexible probe of aluminum, brass, copper, or stainless-steel sheath and formable to a 4-inch radius.
6. Length: As required by application to cover entire cross section of air tunnel.
7. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
8. Gasket for attachment to duct or equipment to seal penetration airtight.
9. Conduit Connection: 1/2-inch

D. Platinum RTD Outdoor Air Temperature Sensors:

1. 100 or 1000 ohms.
2. Temperature Range: Minus 50 to 275 deg F
3. Probe: Single-point sensor with a stainless-steel sheath.
4. Solar Shield: Stainless steel.
5. Enclosure: NEMA 250, Type 4 or 4X junction box or combination conduit and outlet box with removable cover and gasket.
6. Conduit Connection: 1/2-inch trade size.

E. Platinum RTD Space Air Temperature Sensors:

1. 100 or 1000 ohms.
2. Temperature Range: Minus 50 to 212 deg F
3. Sensor assembly shall include a temperature sensing element mounted under a bright white, non-yellowing, plastic or flush, brushed-aluminum cover.
4. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
5. Concealed wiring connection.

F. Thermal Resistors (Thermistors): Common Requirements:

1. 10,000 ohms at 25 deg C and a temperature coefficient of 23.5 ohms/ohm/deg C.
2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
3. Performance Characteristics:
  - a. Range: Minus 50 to 275 deg F.
  - b. Interchangeable Accuracy: At 77 deg F within 0.5 deg F.
  - c. Repeatability: Within 0.5 deg F.
  - d. Drift: Within 0.5 deg F over 10 years.
  - e. Self-Heating: Negligible.
4. Transmitter optional, contingent on compliance with end-to-end control accuracy.

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G. Thermistor, Single-Point Duct Air Temperature Sensors:

1. Temperature Range: Minus 50 to 275 deg F
2. Probe: Single-point sensor with a stainless-steel sheath.
3. Length: As required by application to achieve tip at midpoint of air tunnel, up to 18 inches.
4. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
5. Gasket for attachment to duct or equipment to seal penetration airtight.
6. Conduit Connection: 1/2- inch trade size

H. Thermistor Averaging Air Temperature Sensors:

1. Temperature Range: Minus 50 to 275 deg F
2. Multiple sensors to provide average temperature across entire length of sensor.
3. Rigid probe of aluminum, brass, copper, or stainless-steel sheath.
4. Flexible probe of aluminum, brass, copper, or stainless-steel sheath and formable to a 4-inch radius.
5. Length: As required by application to cover entire cross section of air tunnel.
6. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
7. Gasket for attachment to duct or equipment to seal penetration airtight.
8. Conduit Connection: 1/2-inch trade size.

I. Thermistor Outdoor Air Temperature Sensors:

1. Temperature Range: Minus 50 to 275 deg F
2. Probe: Single-point sensor with a stainless-steel sheath.
3. Solar Shield: Stainless steel.
4. Enclosure: NEMA 250, Type 4 or 4X junction box or combination conduit and outlet box with removable cover and gasket.
5. Conduit Connection: 1/2-inch trade size.

J. Thermistor Space Air Temperature Sensors:

1. Temperature Range: Minus 50 to 212 deg F
2. Sensor assembly shall include a temperature sensing element mounted under a bright white, non-yellowing, plastic or flush, brushed-aluminum cover.
3. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
4. Concealed wiring connection.

K. Space Air Temperature Sensors for Use with DDC Controllers Controlling Terminal Units:

1. 100- or 1000-ohm platinum RTD or thermistor.
2. Thermistor:
  - a. Pre-aged, burned in, and coated with glass; inserted in a metal sleeve; and entire unit encased in epoxy.
  - b. Thermistor drift shall be less than plus or minus 0.5 deg F over 10 years.
3. Temperature Transmitter Requirements:

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- a. Mating transmitter required with each 100-ohm RTD.
  - b. Mating transmitters optional for 1000-ohm RTD and thermistor, contingent on compliance with end-to-end control accuracy.
- 4. Provide digital display of sensed temperature.
- 5. Provide sensor with local control.
  - a. Local override to turn HVAC on.
  - b. Local adjustment of temperature set point.
  - c. Both features shall be capable of manual override through control system operator.

## 2.3 AIR TEMPERATURE SWITCHES

### A. Thermostat and Switch for Low Temperature Control in Duct Applications:

- 1. Description:
  - a. Two-position control.
  - b. Field-adjustable set point.
  - c. Manual or automatic reset as indicated on Drawings.
  - d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2. Performance:
  - a. Operating Temperature Range: 15 to 55 deg F.
  - b. Temperature Differential: 5 deg F, non-adjustable and additive.
  - c. Enclosure Ambient Temperature: Minus 20 to 140 deg F.
  - d. Sensing Element Maximum Temperature: 250 deg F.
  - e. Voltage: 120-V ac.
  - f. Current: 16 FLA.
  - g. Switch Type: Two SPDT snap switches operate on coldest 12-inch section along element length.
- 3. Construction:
  - a. Vapor-Filled Sensing Element: Nominal 20 feet long.
  - b. Dual Temperature Scale: Fahrenheit and Celsius visible on face.
  - c. Set-Point Adjustment: Screw.
  - d. Enclosure: Painted metal, NEMA 250, Type 1.
  - e. Electrical Connections: Screw terminals.
  - f. Conduit Connection: 1/2-inch trade size.

## 2.4 AIR TEMPERATURE RTD TRANSMITTERS

- A. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.
- B. House electronics in NEMA 250 enclosure.

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1. Duct: Type 1.
2. Outdoor: Type 4 or Type 4X.
3. Space: Type 1.

C. Conduit Connection: 1/2-inch

D. Functional Characteristics:

1. Input:
  - a. 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.
  - b. 1000-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.
2. Span (Adjustable):
  - a. Space: 40 to 90 deg F.
  - b. Supply Air Cooling and Heating: 40 to 120 deg F.
  - c. Supply Air Cooling Only: 40 to 90 deg F.
  - d. Supply Air Heating Only: 40 to 120 deg F.
  - e. Exhaust Air: 50 to 100 deg F.
  - f. Return Air: 50 to 100 deg F.
  - g. Mixed Air: Minus 40 to 140 deg F.
  - h. Outdoor: Minus 40 to 140 deg F.
3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc .
4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F.
5. Match sensor with temperature transmitter and factory calibrate together.

E. Performance Characteristics:

1. Calibration Accuracy: Within 0.1 percent of the span.
2. Stability: Within 0.2 percent of the span for at least 6 months.
3. Combined Accuracy: Within 0.5 percent.

## 2.5 LIQUID TEMPERATURE SENSORS, COMMERCIAL GRADE

A. RTD:

1. Description:
  - a. Platinum with a value of 100 or 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
  - b. Encase RTD in a stainless-steel sheath with a 0.25-inch OD.
  - c. Sensor Length: 4, 6, or 8 inches as required by application.
  - d. Process Connection: Threaded, NPS 1/2
  - e. Two-stranded copper lead wires.
  - f. Powder-coated steel enclosure, NEMA 250, Type 4.

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- g. Conduit Connection: 1/2-inch
- h. Performance Characteristics:
  - 1) Range: Minus 40 to 210 deg F.
  - 2) Interchangeable Accuracy: Within 0.54 deg F at 32 deg F.

B. Thermowells:

- 1. Stem: Straight or stepped shank formed from solid bar stock.
- 2. Material: Brass.
- 3. Process Connection: Threaded, NPS 3/4.
- 4. Sensor Connection: Threaded, NPS 1/2.
- 5. Bore: Sized to accommodate sensor with tight tolerance between sensor and well.
- 6. Furnish thermowells installed in insulated pipes and equipment with an extended neck.
- 7. Length: 4, 6, or 8 inches as required by application.
- 8. Thermowells furnished with heat-transfer compound to eliminate air gap between wall of sensor and thermowell and to reduce time constant.

2.6 LIQUID TEMPERATURE SWITCHES

A. Thermostat and Switch for Temperature Control in Pipe Applications:

- 1. Description:
  - a. Two-position control.
  - b. Field-adjustable set point.
  - c. Manual reset.
  - d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2. Performance:
  - a. Operating Temperature Range: 65 to 200 deg F.
  - b. Temperature Differential Deadband: 5 to 30 deg F, adjustable.
  - c. Enclosure Ambient Temperature: 150 deg F.
  - d. Sensing Element Pressure Rating: 200 psig.
  - e. Voltage: 120-V ac.
  - f. Current: 8 FLA.
  - g. Switch Type: SPDT snap switch.
- 3. Construction:
  - a. Vapor-Filled Immersion Element: Copper, nominal 3 inches long.
  - b. Temperature Scale: Fahrenheit, visible on face.
  - c. Set-Point Adjustment: Screw.
  - d. Enclosure: Painted metal, NEMA 250, Type 1.
  - e. Electrical Connections: Screw terminals.
  - f. Conduit Connection: 3/4-inch.

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2.7 LIQUID TEMPERATURE TRANSMITTERS, COMMERCIAL GRADE

- A. House electronics in NEMA 250, Type 4 enclosure.
- B. Enclosure Connection: 1/2-inch trade size.
- C. Functional Characteristics:
  - 1. Input: 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two- or three-wire sensors.
  - 2. Default Span (Adjustable):
    - a. Chilled Water: Zero to 100 deg F.
    - b. Condenser Water: Zero to 120 deg F.
    - c. Heating Hot Water: 32 to 212 deg F.
    - d. Heat Recovery: Zero to 120 deg F.
  - 3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc.
  - 4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F.
  - 5. Match sensor with temperature transmitter and factory calibrate together. Each matched sensor and transmitter set shall include factory calibration data traceable to NIST.
- D. Performance Characteristics:
  - 1. Calibration Accuracy: Within 0.1 percent of the span.
  - 2. Stability: Within 0.2 percent of the span for at least 6 months.
  - 3. Combined Accuracy: Within 0.5 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.
- C. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
- D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 TEMPERATURE INSTRUMENT INSTALLATIONS

- A. Mounting Location:
  - 1. Roughing In:
    - a. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
    - b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
      - 1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
      - 2) Do not begin installation without submittal approval of mounting location.
    - c. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.

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2. Install switches and transmitters for air and liquid temperature associated with individual air-handling units and associated connected ductwork and piping near air-handling units co-located in air-handling unit system control panel to provide service personnel a single and convenient location for inspection and service.
3. Install liquid temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
4. Install air temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
5. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Special Mounting Requirements:

1. Temperature instruments having performance impacted by temperature of mounting substrate shall be isolated with an insulating barrier located between instrument and substrate to eliminate effect. Where instruments requiring insulation are located in finished space, conceal insulating barrier in a cover matching the instrument cover.

C. Mounting Height:

1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of 42 to 54 inches above the adjacent floor, grade, or service catwalk or platform.

D. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

E. Space Temperature Sensor Installation:

1. Conceal assembly in an electrical box of sufficient size to house sensor and transmitter, if provided.
2. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.
3. In finished areas, recess electrical box within wall.
4. In unfinished areas, electrical box may be surface mounted if electrical light switches are surface mounted. Use a cast-aluminum electric box for surface-mounted installations.
5. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.

F. Outdoor Air Temperature Sensor Installation:

1. Mount sensor in a discrete location facing north.
2. Protect installed sensor from solar radiation and other influences that could impact performance.



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3. If required to have a transmitter, mount transmitter remote from sensor in an accessible and serviceable location indoors.

G. Single-Point Duct Temperature Sensor Installation:

1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed in center of duct cross section and located to sense near average temperature. Do not exceed 24 inches in sensor length.
2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
3. Rigidly support sensor to duct and seal penetration airtight.
4. If required to have transmitter, mount transmitter remote from sensor at accessible and serviceable location.

H. Averaging Duct Temperature Sensor Installation:

1. Install averaging-type air temperature sensor for temperature sensors located within air-handling units, similar equipment, and large ducts with air tunnel cross-sectional area of 20 sq. ft. and larger.
2. Install sensor length to maintain coverage over entire cross-sectional area. Install multiple sensors where required to maintain the minimum coverage.
3. Fasten and support sensor with manufacturer-furnished clips to keep sensor taut throughout entire length.
4. If required to have transmitter, mount transmitter in an accessible and serviceable location.

I. Low-Limit Air Temperature Switch Installation:

1. Install multiple low-limit switches to maintain coverage over entire cross-sectional area of air tunnel.
2. Fasten and support sensing element with manufacturer-furnished clips to keep element taut throughout entire length.
3. Mount switches outside of airstream at a location and mounting height to provide easy access for switch set-point adjustment and manual reset.
4. Install on entering side of cooling coil unless otherwise indicated on Drawings.

J. Liquid Temperature Sensor Installation:

1. Assembly shall include sensor, thermowell.
2. For pipe NPS 4 and larger, install sensor and thermowell length to extend into pipe between 50 to 75 percent of pipe cross section.
3. For pipe smaller than NPS 4:
  - a. Install reducers to increase pipe size to NPS 4 at point of thermowell installation.
  - b. For pipe sizes NPS 2-1/2 and NPS 3, thermowell and sensor may be installed at pipe elbow or tee to achieve manufacturer-recommended immersion depth in lieu of increasing pipe size.
  - c. Minimum insertion depth shall be 2-1/2 inches.
4. Install matching thermowell.
5. Fill thermowell with heat-transfer fluid before inserting sensor.

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6. Tip of spring-loaded sensors shall contact inside of thermowell.
7. For insulated piping, install thermowells with extension neck to extend beyond face of insulation.
8. Install thermowell in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement. If top dead center location is not possible due to field constraints, install thermowell at location along top half of pipe.
9. For applications with transmitters, mount transmitter remote from sensor in an accessible and serviceable location from floor.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved nameplate with instrument identification.

### 3.6 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.
- B. Wash and shine glazing.
- C. Polish glossy surfaces to a clean shine.

### 3.7 CHECK-OUT PROCEDURES

- A. Check installed products before continuity tests, leak tests, and calibration.
- B. Check temperature instruments for proper location and accessibility.
- C. Verify sensing element type and proper material.
- D. Verify location and length.
- E. Verify that wiring is correct and secure.

### 3.8 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:
  1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
  2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

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3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

### 3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform according to manufacturer's written instruction.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Prepare test and inspection reports.

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3.10 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.11 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain temperature instruments.

END OF SECTION

SECTION 230923.53 – VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. DDC: Direct digital control.
- C. EMI: Electromagnetic interference.
- D. LED: Light-emitting diode.
- E. NC: Normally closed.
- F. NO: Normally open.
- G. OCPD: Overcurrent protective device.
- H. PID: Control action, proportional plus integral plus derivative.
- I. RFI: Radio-frequency interference.
- J. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type and rating of VFC indicated. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Include dimensions and finishes for VFCs.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

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C. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Certificates: For each VFC from manufacturer.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
    - b. Manufacturer's written instructions for setting field-adjustable overload relays.
    - c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
    - d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

#### A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

#### B. Application: Variable torque for centrifugal fans.

#### C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

#### D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

#### E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

#### F. Unit Operating Requirements:

1. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
2. Humidity Rating: Less than 95 percent (noncondensing).
3. Altitude Rating: Not exceeding 3300 feet.
4. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
5. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.

#### G. Inverter Logic: Microprocessor based, isolated from all power circuits.

#### H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

#### I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.

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4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. Critical frequency rejection, with three selectable, adjustable deadbands.
6. Instantaneous line-to-line and line-to-ground overcurrent trips.
7. Loss-of-phase protection.
8. Reverse-phase protection.
9. Short-circuit protection.
10. Motor-overtemperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

## 2.2 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

C. Control Signal Interfaces:



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1. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
  - a. 0- to 10-V dc.
  - b. 4- to 20-mA dc.
2. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
  - a. Motor running.
  - b. Set point speed reached.
  - c. Fault and warning indication (overtemperature or overcurrent).
  - d. PID high- or low-speed limits reached.

## 2.3 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
  1. Dry and Clean Indoor Locations: Type 1.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall.

### 3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and existing building DDC system. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."

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- B. Bundle, train, and support wiring in enclosures.

### 3.4 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each VFC with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.

### 3.5 FIELD QUALITY CONTROL

- A. The General Contractor shall engage a testing agent to perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
  - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  - 2. Test continuity of each circuit.
  - 3. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify University before starting the motor(s).
  - 4. Test each motor for proper phase rotation.
  - 5. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. VFCs will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

### 3.6 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

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3.7 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

3.8 DEMONSTRATION

- A. Train University's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION

SECTION 232113 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
  - 1. Copper tube and fittings.
  - 2. Steel pipe and fittings.
  - 3. Joining materials.
  - 4. Transition fittings.
  - 5. Dielectric fittings.
  - 6. Bypass chemical feeder.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied. For each type of the following:
  - 1. Pipe.
  - 2. Fittings.
  - 3. Joining materials.
  - 4. Bypass chemical feeder.
- C. Piping Schedule: Identify type of material fittings, and joining method to be used for each piping application and size range.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Other building services.
  - 3. Structural members.

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- C. Qualification Data: For Installer.
- D. Welding certificates.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
  - 1. Hot-Water Heating Piping: 100 psig at 200 deg F.
  - 2. Makeup-Water Piping: 150 psig at 150 deg F.
  - 3. Condensate-Drain Piping: 180 deg F.
  - 4. Air-Vent Piping: 200 deg F.
  - 5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. DWV Copper Tubing: ASTM B 306, Type DWV.
- C. Wrought-Copper, Solder Joint Pressure Fittings, Unions, and Flanges: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

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- C. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- D. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- E. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.
  - 1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe.

2.5 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Description:
    - a. Standard: ASSE 1079.
    - b. Pressure Rating: 125 psig minimum at 180 deg F.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous.

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C. Dielectric Flanges:

1. Description:

- a. Standard: ASSE 1079.
- b. Factory-fabricated, bolted, companion-flange assembly.
- c. Pressure Rating: 125 psig minimum at 180 deg F.
- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig.
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Description:

- a. Standard: IAPMO PS 66.
- b. Electroplated steel nipple, complying with ASTM F 1545.
- c. Pressure Rating: 300 psig at 225 deg F.
- d. End Connections: Male threaded or grooved.
- e. Lining: Inert and noncorrosive, propylene.

2.7 BYPASS CHEMICAL FEEDER

- A. Description: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

- B. Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating, radiant-heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

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2. Schedule 40, Grade B steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating, radiant-heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:
  1. Schedule 40 steel pipe, cast-iron flanges and flange fittings, and welded and flanged joints.
- C. Makeup-water piping installed aboveground shall be the following:
  1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- E. Air-Vent Piping:
  1. Inlet: Same as service where installed.
  2. Outlet: Copper tubing with soldered joints.
- F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

### 3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.



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- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to the following:
  - 1. Section 230523.12 "Ball Valves for HVAC Piping."
  - 2. Section 230523.14 "Check Valves for HVAC Piping."
  - 3. Section 230523.15 "Gate Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

### 3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits or nipples.

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- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548.13 "Vibration Controls for HVAC" for vibration isolation requirements.
- C. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
  5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet.
  2. NPS 1: Maximum span, 7 feet.
  3. NPS 1-1/2: Maximum span, 9 feet.
  4. NPS 2: Maximum span, 10 feet.
  5. NPS 2-1/2: Maximum span, 11 feet.
  6. NPS 3 and Larger: Maximum span, 12 feet.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

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3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 CHEMICAL TREATMENT

- A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:

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1. pH: 9.0 to 10.5.
2. "P" Alkalinity: 100 to 500 ppm.
3. Boron: 100 to 200 ppm.
4. Soluble Copper: Maximum of 0.20 ppm.
5. Total Suspended Solids: Maximum of 10 ppm.
6. Ammonia: Maximum of 20 ppm.

B. Install bypass chemical feeders in each hydronic system where indicated.

1. Install in upright position with top of funnel not more than 48 inches above the floor.
2. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
3. Install NPS 3/4 pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.

C. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

D. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

E. Fill systems that have antifreeze or glycol solutions with the following concentrations:

1. MAU-1 Heating-Water Piping: Minimum of 35 percent propylene glycol.

### 3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. The General Contractor shall engage a testing agent to perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to

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pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 232116 – HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following:
  - 1. Hydronic specialty valves.
  - 2. Air-control devices.
  - 3. Strainers.
  - 4. Connectors.
  - 5. Packaged glycol make-up unit.
- B. Related Requirements:
  - 1. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
  - 2. Section 230523.15 "Gate Valves for HVAC Piping" for specification and installation requirements for gate valves common to most piping systems.
  - 3. Section 230923.11 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of the following. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Hydronic Specialty Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
  - 2. Air-control devices.
  - 3. Strainers.
  - 4. Connectors.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTY VALVES

- A. Bronze, Calibrated-Orifice, Balancing Valves:
  - 1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
  - 2. Ball: Brass or stainless steel.
  - 3. Plug: Resin.
  - 4. Seat: PTFE.
  - 5. End Connections: Threaded or socket.
  - 6. Pressure Gage Connections: Integral seals for portable differential pressure meter.
  - 7. Handle Style: Lever, with memory stop to retain set position.
  - 8. CWP Rating: Minimum 125 psig.
  - 9. Maximum Operating Temperature: 250 deg F.
- B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
  - 1. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
  - 2. Ball: Brass or stainless steel.
  - 3. Stem Seals: EPDM O-rings.
  - 4. Disc: Glass and carbon-filled PTFE.
  - 5. Seat: PTFE.
  - 6. End Connections: Flanged or grooved.
  - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
  - 8. Handle Style: Lever, with memory stop to retain set position.
  - 9. CWP Rating: Minimum 125 psig.
  - 10. Maximum Operating Temperature: 250 deg F.

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C. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Low inlet-pressure check valve.
7. Inlet Strainer: Removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

D. Diaphragm-Operated Safety Valves: ASME labeled.

1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Wetted, Internal Work Parts: Brass and rubber.
7. Inlet Strainer: Removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

C. Bladder-Type Expansion Tanks:



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1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

E. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig.
3. Maximum Operating Temperature: Up to 300 deg F.

## 2.3 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

B. Magnetic Strainers:

1. Body: 304L stainless steel with bolted cover and bottom drain connection.
2. End Connections: Flanged, ASME B16.5 Class 150.
3. Magnets: High power NdFeB
4. Pocket Sleeves: 304L stainless steel.
5. CWP Rating: 125 psig.
6. Provide ASME approved basis of design filter, Grundfoss MagFilter, or approved equivalent.

## 2.4 CONNECTORS

A. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.

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2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

## 2.5 PACKAGED GLYCOL MAKE-UP UNIT

- A. Packaged automatic glycol solution make up unit. The package shall consist of a base, 55 gallon polyethylene reservoir with removable lid and visible solution level scale in gallons and liters, y-strainer, isolation valve, pump, open drip-proof motor, pump isolation, check and balance valve, expansion tank, discharge pressure gage, motor contactor, pressure control and necessary interconnecting piping. Pump shall start based on falling pressure. Green light shall indicate power supplied to unit. Unit shall include 3/4 inch piping connection, low level cutout with red indicator light and 110 V contact for alarm indication, to stop running pump during low level condition.

## PART 3 - EXECUTION

### 3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

### 3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

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- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION

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SECTION 232123 – HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Close-coupled, in-line centrifugal pumps.
  - 2. Separately coupled, base-mounted, end-suction centrifugal pumps.
  - 3. Wet-rotor pumps.
  - 4. Automatic condensate pump units.

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Shop Drawings: For each pump.
  - 1. Show pump layout and connections.
  - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
  - 3. Include diagrams for power, signal, and control wiring.
- D. Provide equipment cut sheets to General Contractor for inclusion in project coordination drawings. Include all equipment dimensions, noting manufacturer's clearance requirements, as well as location and sizes of all equipment connections.

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1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.7 WARRANTY

- A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of centrifugal pumps that fail in material or workmanship within specified warranty period.
  - 1. Extended Warranty Period:
    - a. For Parts: Two years.
    - b. For Labor: Two years.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Armstrong Pumps, Inc.
  - 2. Bell and Gossett.
  - 3. Grundfos Pumps Corporation.
  - 4. TACO Incorporated.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
- C. Capacities and Characteristics: As scheduled on Drawings.
- D. Pump Construction:

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1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.
  2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
  3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
  4. Pump Bearings: Permanently lubricated ball bearings.
- E. Motor: Single speed and rigidly mounted to pump casing.
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - a. Enclosure: Open, dripproof.
    - b. Motor Bearings: Permanently lubricated ball bearings.
    - c. Efficiency: Premium efficient.

2.2 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Armstrong Pumps, Inc.
  2. Bell and Gossett.
  3. Grundfos Pumps Corporation.
  4. TACO Comfort Solutions, Inc.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.
- C. Capacities and Characteristics: As scheduled on Drawings.
- D. Pump Construction:
1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
  2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
  3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
  4. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.

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- E. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor.
- F. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
- G. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
- H. Motor: Single speed, secured to mounting frame, with adjustable alignment.
  - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - a. Enclosure: Open, dripproof.
    - b. Motor Bearings: Permanently lubricated ball bearings.
    - c. Efficiency: Premium efficient.

2.3 WET-ROTOR PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Armstrong Pumps, Inc.
  - 2. Grundfos Pumps Corporation.
  - 3. TACO Incorporated.
- B. Description: Factory-assembled and -tested, wet-rotor pump.
- C. Capacities and Characteristics: As scheduled on Drawings.
- D. Pump Construction:
  - 1. Body: Cast iron.
  - 2. Impeller: Polypropylene or noryl.
  - 3. Pump Shaft: Ceramic or stainless steel.
  - 4. Bearings. Double-sintered carbon.
- E. Motor: Single speed.
  - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

- a. Efficiency: Premium efficient.

## 2.4 AUTOMATIC CONDENSATE PUMP UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. Beckett Corporation.
  2. Hartell Pumps; Milton Roy.
  3. Little Giant Pump Co.
  4. Mepco, LLC.
- B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a minimum, electrical power cord with plug.
- C. Capacities and Characteristics: As scheduled on Drawings.

## 2.5 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser:
  1. Angle pattern. pressure rating, cast or ductile-iron body and end cap, pump-inlet fitting.
  2. Bronze startup and bronze or stainless-steel permanent strainers.
  3. Bronze or stainless-steel straightening vanes.
  4. Drain plug.
  5. Factory-fabricated support.
- B. Triple-Duty Valve: Not allowed.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.



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3.2 PUMP INSTALLATION

- A. Comply with HI 1.4 and HI 2.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- E. Equipment Mounting:
  - 1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- F. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.
  - 1. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 ALIGNMENT

- A. Perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Where installing piping adjacent to pump, allow space for service and maintenance.
- B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

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- D. Install check, shut-off, and balancing valves with memory stop on discharge side of pumps.
- E. Install suction diffuser, Y-type strainer, and shutoff valve on suction side of pumps.
- F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valves.
- H. Install check valve and gate or ball valve on each condensate pump unit discharge.
- I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.
    - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - c. Verify that pump is rotating in the correct direction.
  - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 6. Start motor.
  - 7. Open discharge valve slowly.

### 3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Provide one hour of training for each pump provided.

END OF SECTION

## SECTION 233113 – METAL DUCTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sealants and gaskets.
  - 5. Hangers and supports.
  - 6. Duct Liner.

- B. Related Sections:

- 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied. For each type of the following products:

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1. Sealants and gaskets.
2. Liners and adhesives.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items penetrating finished ceiling including the following:
    - a. Luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Perimeter moldings.
- C. Delegated-Design Submittal:
  1. Sheet metal thicknesses.
  2. Joint and seam construction and sealing.
  3. Reinforcement details and spacing.
  4. Materials, fabrication, assembly, and spacing of hangers and supports.
- D. Welding certificates.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

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- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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1. Fabricate round ducts larger than in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  1. Galvanized Coating Designation: .
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, minimum diameter for lengths or less; minimum diameter for lengths longer than .

## 2.4 DUCT LINER

- A. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
  1. Provide fiberglass duct liner with an anti-microbial coating on airstream surfaces.
  2. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  3. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  4. Butt transverse joints without gaps, and coat joint with adhesive.

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5. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
6. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely, at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

## 2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: , positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
  1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
  6. Sealant shall have a VOC content of 420 g/L or less.
  7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
  1. Seal shall provide maximum leakage class of and shall be rated for static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," , "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.



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- H. Install ducts with a clearance of , plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least .
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

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3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," , "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within of each elbow and within of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of .
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

### 3.8 FIELD QUALITY CONTROL

- A. The General Contractor shall engage a testing agent to perform tests and inspections.
- B. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.9 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.

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5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
5. Provide drainage and cleanup for wash-down procedures.
6. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply and Outside-Air Ducts:

1. Ducts Connected to Terminal Units:
  - a. Pressure Class: Positive .
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 24.
  - d. SMACNA Leakage Class for Round: 12.
2. Ducts Connected to Constant-Volume Air-Handling Units:
  - a. Pressure Class: Positive .
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 24.
  - d. SMACNA Leakage Class for Round and Flat Oval: 12.
3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

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- a. Pressure Class: Positive .
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 6.
- d. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Return Ducts:

- 1. Ducts Connected to Terminal Units:
  - a. Pressure Class: Positive or negative .
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 24.
  - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- 2. Ducts Connected to Air-Handling Units:
  - a. Pressure Class: Positive or negative .
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 24.
  - d. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Exhaust Ducts:

- 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
  - a. Pressure Class: Negative .
  - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
  - c. SMACNA Leakage Class for Rectangular: 12.
  - d. SMACNA Leakage Class for Round: 6.
- 2. Ducts Connected to Air-Handling Units:
  - a. Pressure Class: Positive or negative .
  - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
  - c. SMACNA Leakage Class for Rectangular: 12.
  - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- 3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
  - a. Exposed to View: Type 304, stainless-steel sheet, No. 3 finish.
  - b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
  - c. Welded seams and joints.
  - d. Pressure Class: Positive or negative .
  - e. Airtight/Watertight.
  - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
  - g. SMACNA Leakage Class: 3.
- 4. Ducts Connected to Dishwasher Hoods:

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- a. Type 304, stainless-steel sheet.
- b. Exposed to View: No. 3 finish.
- c. Concealed: No. 2D finish.
- d. Welded seams and flanged joints with watertight EPDM gaskets.
- e. Pressure Class: Positive or negative .
- f. Airtight/Watertight.
- g. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
- h. SMACNA Leakage Class: 3.

E. Intermediate Reinforcement:

- 1. Galvanized-Steel Ducts: Galvanized steel.
- 2. Stainless-Steel Ducts:
  - a. Exposed to Airstream: Match duct material.
  - b. Not Exposed to Airstream: Match duct material.

F. Elbow Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, and Larger in Diameter: Standing seam.

G. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Spin in.

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2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity : Conical tap.
  - b. Velocity or Higher: 45-degree lateral.

END OF SECTION

## SECTION 233300 – AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Backdraft dampers.
2. Manual volume dampers.
3. Fire dampers.
4. Turning vanes.
5. Duct-mounted access doors.
6. Flexible connectors.
7. Duct accessory hardware.

- B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
3. Section 284621.11 "Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.



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- C. Source quality-control reports.

## 1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.

## PART 2 - PRODUCTS

### 2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

### 2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: .
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- C. Carbon-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and a No. 4 finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, minimum diameter for lengths or less; minimum diameter for lengths longer than .

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2.3 BACKDRAFT DAMPERS

- A. Description: Gravity balanced.
- B. Maximum Air Velocity: .
- C. Maximum System Pressure: .
- D. Frame: Hat-shaped, thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
- E. Blades: Multiple single-piece blades, off-center pivoted or end pivoted, maximum width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- F. Blade Action: Parallel.
- G. Blade Seals: Extruded vinyl, mechanically locked.
- H. Blade Axles:
  - 1. Material: Stainless steel.
  - 2. Diameter: .
- I. Tie Bars and Brackets: Aluminum.
- J. Return Spring: Adjustable tension.
- K. Bearings: Synthetic pivot bushings.
- L. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
  - 2. Counterweights and spring-assist kits for vertical airflow installations.
  - 3. Electric actuators.
  - 4. Chain pulls.
  - 5. Screen Mounting: Front mounted in sleeve.
    - a. Sleeve Thickness: minimum.
    - b. Sleeve Length: minimum.
  - 6. Screen Mounting: Rear mounted.
  - 7. Screen Material: Galvanized steel.
  - 8. Screen Type: Bird.
  - 9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Standard leakage rating, with linkage outside airstream.

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2. Suitable for horizontal or vertical applications.
3. Frames:
  - a. Frame: Hat-shaped, thick, galvanized sheet steel.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized-steel, thick.
5. Blade Axles: Galvanized steel.
6. Bearings:
  - a. Molded synthetic.
  - b. Dampers in ducts with pressure classes of or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of thick zinc-plated steel, and a hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

## 2.5 FIRE DAMPERS

- A. Type: Static; rated and labeled according to UL 555 by an NRTL.
- B. Fire Rating: 1-1/2 and 3 hours.
- C. Frame: Curtain type with blades outside airstream except where located behind grille where blades may be inside airstream; fabricated with roll-formed, thick galvanized steel; with mitered and interlocking corners.
- D. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

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1. Minimum Thickness: or thick, as indicated, and of length to suit application.
  2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed, interlocking, thick, galvanized sheet steel. In place of interlocking blades, use full-length, thick, galvanized-steel blade connectors.
- G. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- H. Heat-Responsive Device: Replaceable, rated, fusible links.

## 2.6 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- C. Vane Construction: Single wall.

## 2.7 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures , "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  3. Number of Hinges and Locks:
    - a. Access Doors Less Than Square: No hinges and two sash locks.
    - b. Access Doors up to Square: Two hinges and two sash locks.

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2.8 FLEXIBLE CONNECTORS

- A. Materials: Flame-retardant or noncombustible fabrics.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip wide attached to two strips of wide, thick, galvanized sheet steel or thick aluminum sheets. Provide metal compatible with connected ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: .
  - 2. Tensile Strength: in the warp and in the filling.
  - 3. Service Temperature: .
- E. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.9 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

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- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and stainless-steel accessories in stainless-steel ducts.
- C. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channel of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct-mounted coils.
  - 2. At outdoor-air intakes and mixed-air plenums.
  - 3. Downstream from control dampers, backdraft dampers, and equipment.
  - 4. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 5. At each change in direction and at maximum spacing.
  - 6. Upstream and downstream from turning vanes.
  - 7. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
  - 1. One-Hand or Inspection Access: .
  - 2. Two-Hand Access: .
  - 3. Head and Hand Access: .
  - 4. Head and Shoulders Access: .
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts directly.

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- N. Connect diffusers to ducts directly or with maximum lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands and adhesive plus sheet metal screws.
- P. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

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SECTION 233600 – AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Shutoff, single-duct air terminal units.
  - 2. Casing liner.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of air terminal unit. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings: For air terminal units.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
  - 4. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.



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- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Size and location of initial access modules for acoustic tile.
  - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Instructions for resetting minimum and maximum air volumes.
    - b. Instructions for adjusting software set points.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- B. Casing: thick galvanized steel, single wall.
  - 1. Casing Liner: Comply with requirements in "Casing Liner" Article for flexible elastomeric duct liner.
  - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.

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3. Air Outlet: S-slip and drive connections.
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
  5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at inlet static pressure.
  2. Damper Position: Normally open.
- D. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than , and rated for a minimum working pressure of and a maximum entering-water temperature of . Include manual air vent and drain valve.
- E. Control devices shall be compatible with temperature controls system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
1. Factory-installed multipoint velocity sensor at air inlet.
- F. Controls:
1. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg inlet static pressure.

## 2.3 CASING LINER

- A. Casing Liner: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Minimum Thickness: .
  2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

## 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to AHRI 880.
1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, and AHRI certification seal.

### PART 3 - EXECUTION

#### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Coordinate locations of concrete inserts with locations of radiant tubing in second floor slab prior to installation.
  - 2. Where practical, install concrete inserts before placing concrete.
  - 3. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 4. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than thick.
  - 5. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than thick.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

#### 3.2 TERMINAL UNIT INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

#### 3.3 CONNECTIONS

- A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- B. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.

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- D. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

### 3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. The General Contractor shall engage a testing agent to perform the following tests and inspections:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.6 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
  - 3. Verify that controls and control enclosure are accessible.
  - 4. Verify that control connections are complete.
  - 5. Verify that nameplate and identification tag are visible.
  - 6. Verify that controls respond to inputs as specified.

### 3.7 DEMONSTRATION

- A. Train University's maintenance personnel to adjust, operate, and maintain air terminal units.

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END OF SECTION

SECTION 238126 – SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Provide equipment cut sheets to General Contractor for inclusion in project coordination drawings. Include all equipment dimensions, noting manufacturer’s clearance requirements, as well as location and sizes of all equipment connections.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Field quality-control reports.
- C. Warranty: Sample of special warranty.

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1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set(s) for each A/C unit.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
  - 1. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.8 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: Five year(s) from date of Substantial Completion.
    - c. For Labor: Two year(s) from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide Mitsubishi product indicated on Drawings or comparable product by one of the following:
1. Carrier Corporation; a unit of United Technologies Corp.
  2. Fujitsu General American, Inc.
  3. SANYO North America Corporation.
  4. Trane.
  5. YORK; a Johnson Controls company.
  6. Samsung.

2.2 INDOOR UNITS ( OR LESS)

- A. Wall-Mounted, Evaporator-Fan Components:
1. Cabinet: Casing shall have a smooth front, while finish with removable panels on front and ends, and discharge drain pans with drain connection.
  2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  3. Fan: Direct drive, centrifugal.
  4. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    - c. Enclosure Type: Totally enclosed, fan cooled.
    - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
    - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
  5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  6. Condensate Drain Pans:
    - a. Single-wall, galvanized steel sheet.
    - b. Drain Connection: Located at lowest point of pan and sized to prevent overflow.
    - c. Provide manufacturer's integral condensate lift pump, or separate lift pump integrated in lineset cover assembly.
  7. Filters: Permanent, cleanable.



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2.3 OUTDOOR UNITS ( OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - a. Compressor Type: DC inverter-driven twin rotary.
  - b. Refrigerant: R-410A.
  - c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.
5. Low Ambient Kit: Permits operation down to 0.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan, with the following features:
1. Compressor time delay.
  2. 24-hour time control of system stop and start.
  3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  4. Fan-speed selection including auto setting.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.

2.5 REFRIGERANTS

- A. ASHRAE 34, R-410A: Penrafluoroethane/Difluoromethane.

2.6 REFRIGERANT LINESET COVERS

A. Interior Lineset Covers:

1. Interior linear duct designed specifically for enclosing refrigerant linesets. Fabricate from rigid polyvinyl chloride with rounded edges and snap in place fittings for a smooth

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finish. Cover shall be easily removable for future access without damaging duct assembly.

B. Exterior Lineset Covers:

1. Exterior heavy duty linear duct designed specifically for enclosing refrigerant linesets. Fabricate from heavy duty, rigid, polyvinyl chloride a UV and weather resistant exterior. Straight lengths of round duct shall be two piece units with snap lock seams. Fitting and splice covers shall be heavy duty, two-piece fittings secured with manufacturer's stainless steel screws.
2. Provide stainless steel escutcheon around duct penetration of exterior wall.
3. Finish Color: Ivory.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
  1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 PIPING INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Where piping is indicated to be exposed, provide lineset covers.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping adjacent to machines to allow service and maintenance.

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- F. Install piping free of sags and bends.
- G. Select system components with pressure rating equal to or greater than system operating pressure.
- H. Install piping as short and direct as possible, with a minimum number of bends.
- I. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- J. Identify refrigerant piping according to Section 230553 "Identification for HVAC Piping and Equipment."
- K. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- L. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, start-up, and adjust components, assemblies, and equipment installations, including connections.
- B. The General Contractor shall engage a testing agent to perform tests and inspections.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

### 3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Perform BacNet interface startup and programming. Coordinate with DDC Contractor for programming requirements.

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3.5 DEMONSTRATION

- A. Train University's maintenance personnel to adjust, operate, and maintain units.
- B. Provide 2 hours of training per unit.

END OF SECTION

SECTION 238146 – MODULAR WATER-TO-WATER HEAT PUMPS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work Included

The water-source modular simultaneous heating and cooling chiller system shall consist of individual modules that are assembled on site. Each module shall be completely factory wired and tested prior to shipment. Each module shall include a compressor, brazed plate evaporator, brazed plate condenser, geothermal fluid brazed plate heat exchanger, and controls. The controls shall also be designed to operate on a distributed master control system which allows each individual slave microprocessor to operate on its own temperature sensors if there is a failure of the master microprocessor.

1.02 QUALITY ASSURANCE

- A. Heat Pump modules shall be constructed in accordance with the UL 60335-2-40 and NEC standards and be UL or ETL listed.
- B. Heat Pump modules shall meet the safety standards of ANSI/ASHRAE 15 – Safety Standard for Refrigerated Systems.

1.03 SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Submit complete drawings including cabinet dimensional details and anchor point locations, required clearances, location and sizes of field connections, performance data, electrical wiring diagrams, dry and operation weights, and all required electrical data.
- C. Submit manufacturer's installation instructions, including any remote panel installation instructions.
- D. Operating and Maintenance manuals: provide two copies of current commercial manuals.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting modules.
- B. Protect modules on site from physical damage after unloading.

1.05 WARRANTY

- A. Entire unit: Manufacturer one-year parts and labor. Compressor: five years parts only.

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PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Trane Thermafit MWS (Basis of Design)
- B. Engineer Approved Equal (provide complete submittal, listing all exceptions to specification, to engineer for evaluation prior to bid, per substitution request requirements)

2.02 MODULAR HEAT PUMP SIMULTANEOUS HEATING and COOLING SYSTEM

- A. General  
Each module shall be assembled on an integral white painted formed sheet metal steel frame. The module shall be shipped individually and assembled on site. Each module shall be fully charged with refrigerant and factory tested for capacity and controller functions prior to shipment. The module system must be built for single point power supply connection to a central distribution block inside an electrical power distribution panel and shall incorporate circuit breaker overload protection for each module. Electrical supply to each module shall consist of flexible conduit from the power distribution panel. No electrical connection to a module shall carry the load of more than that module. The electrical supply conduit shall be factory assembled and shipped with each module for field connection into the power distribution panel

The modular simultaneous heating and cooling system is designed to have individual modules to operate in a heating mode, cooling mode or simultaneous heating and cooling based on the system demand. The modular system contains independent fluids loops that are never mixed for hot and cold load fluids and the source/sink fluid. The cold load fluid has a dedicated evaporator, the hot load fluid has a dedicated condenser and the source/sink fluid has a dedicated heat exchanger that operates as an evaporator or condenser depending on the operating mode. The single refrigeration circuit includes check valves and solenoid valves and actuated ball valves that directs flow to relevant evaporator, condenser and/or source/sink heat exchanger.

- B. Frame  
Frame shall be constructed of formed sheet metal externally coated with white painted finish and internally coated in black. Assembly of all modules on a single frame for shipment to the jobsite as a single unit
- C. Cabinet  
Cabinet panels are made of sheet metal externally coated with white painted finish and internally coated in black. The cabinet enclosure shall include easily removable access panels for service. Access panels shall be removable via stainless steel fasteners and retaining clips. Module shall not require access via sheet metal screws or protruding threaded fasteners. Acoustical Cabinet Panels for low noise.
- D. Compressors  
Hermetically sealed scroll tandem compressor set on a single refrigeration circuit, oil level sight glass, suction gas-cooled motor with solid-state sensors in the windings for overload protection, and in-line circuit breaker protection. There shall be two compressors per tandem set and one refrigerant circuit per module. Compressors shall be mounted to the steel frame with rubber-in-shear vibration isolators. Compressor Wraps for Sound Attenuation

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- E.     Evaporators, Condensers and Source/Sink Heat Exchanger  
Each single circuit, brazed plate evaporator, condenser and source/sink heat exchanger is constructed of 316 stainless steel plates and copper brazing and shall be insulated with  $\frac{3}{4}$ " closed cell insulation. The fluid piping to each module shall have an electronic two-way valve for selecting geothermal fluid or load hot or cold fluid depending on the building heating or cooling demands. The supply and return fluid piping from each evaporator, condenser, and source/sink heat exchanger shall include a manual and an electronic valve for servicing each module individually while the remaining modules continue to operate, to allow for variable flow and, on each source/sink heat exchanger operating as a condenser, to control refrigeration head pressure. The fluid connections to each heat exchanger shall use roll grooved couplings for service convenience and ease of installation.
- F.     Flow Switches  
A thermal dispersion flow switch is provided on the discharge of each evaporator and source/sink heat exchanger for individual module flow verification on the cold fluid loop during cooling only mode and source/sink fluid loop during heating only mode when the heat exchanger is operating as an evaporator.
- G.     Strainers  
A compact suction diffuser with stainless steel 40 mesh strainer shall be factory installed on the branch line to each evaporator, condenser, and source/sink heat exchanger inlet.
- H.     Isolation valves  
The strainer and flow switch can be serviced by manually closing the isolation valves on each evaporator, condenser, and source/sink heat exchanger branch line. The strainers and flow switches can be removed/replaced and the strainers cleaned without shutting down the fluid flow to the entire system to allow the remaining modules to continue to operate.
- I.     Refrigerant piping  
Piping shall be Type K seamless copper. The suction line shall have closed cell pipe insulation, solenoid valves, check valves, and actuated ball valves in the suction, discharge, and liquid lines.
- J.     Fluid piping  
The fluid piping shall be 6" Schedule 10 steel and shall have closed cell pipe insulation to prevent condensation and retain heat and cold. The header pipe in each heat recovery module shall connect to the adjacent module using roll grooved steel couplings and neoprene gaskets.
- K.     Controls  
The master Thermafit MWS module shall incorporate the master microprocessor controller. The master microprocessor shall communicate with the remaining slave microprocessors in each module via a local network communications protocol. The master module shall include a phase monitor to protect against low voltage, phase unbalance, phase loss, and phase reversal conditions. The master controller shall read all analog, binary values and faults from all slave module controllers and shall pass these values to the Building Automation System via BACnet protocols

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Each chiller control system shall include operational digital switches for each compressor; high and low pressure transmitters to provide indication of refrigeration pressures in each circuit; high and low refrigeration pressure alarms that shut down the responsible compressor(s); anti-short cycling compressor timers; minimum compressor run timers; and connection to Building Automation System.

L. Programmable Logic Controller (PLC)

The PLC shall provide the following minimum functions and alarms:

1. Adjustable fluid temperature set point
2. Multiple stage compressor control, including compressor rotation to provide even compressor usage and wear.
3. Reset temperature control set point based on decreased load
4. High and low fluid temperature alarm set points
5. Fluid inlet and outlet temperature
6. Suction and discharge refrigeration pressures on each refrigeration circuit
7. Compressor run status
8. Current alarm status
9. Demand load
10. Compressor run hours
11. Number of compressors starts
12. Alarm logging with minimum of previously 100 logged alarms with time and date of each occurrence
13. Remote start/stop input
14. Dry contact for general alarm
15. 'Smart' compressor demand distribution algorithm across chiller bank, which seamlessly allows unavailable modules to be placed out of sequence and available modules to be placed back in sequence
16. Provide BMS with the information for automatic variable flow control
17. Maintaining minimum flow for chilled water and hot water loops even with no compressors running
18. 'Smart' compressor rotation algorithm within a module which accounts for compressor availability and safety timers
19. Stand-alone fail-safe mode for each module should Master module fail, allowing the chiller system to remain operating

M. Interface Panel

A smart operator touch screen interface panel with graphical display shall be installed on the master module to allow operation and alarm monitoring, adjustment of user set points, and controlled temperatures trending

N. Remote Connection

Remote monitoring of chiller operation is an optional control system feature



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PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's requirements.
  - 1. Level the chiller using the base rail as a reference. The chiller must be level within 1/2" in over the entire length and width. Use shims as necessary to level the chiller.

3.02 SERVICE AND START-UP

- A. Startup - Provide all labor and materials to perform startup. Startup shall be performed by a factory-trained technician from the original equipment manufacturer (OEM). Technician shall confirm that equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty. This shall be done in strict accordance with manufacturer's specifications and requirements. Third-party service agencies are not permitted.
- B. A start-up log shall be furnished by the factory approved start-up technician to document the chiller's start-up date and shall be signed by the owner or his authorized representative prior to commissioning the chillers.

END

SECTION 238236 – FINNED-TUBE RADIATION HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes, finned-tube radiation heaters.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: On data submittal sheets where more than one product is to be described, clearly annotate which product(s) is to be supplied. For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- C. Shop Drawings:
  - 1. Include plans, elevations, sections, and details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include details and dimensions of custom-fabricated enclosures.
  - 4. Indicate location and size of each field connection.
  - 5. Indicate location and arrangement of piping valves and specialties.
  - 6. Indicate location and arrangement of integral controls.
  - 7. Include enclosure joints, corner pieces, access doors, and other accessories.
  - 8. Include diagrams for power, signal, and control wiring.
- D. Color Samples for Initial Selection: For finned-tube radiation heaters with factory-applied color finishes.
- E. Color Samples for Verification: For each type of exposed finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

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- B. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Structural members, including wall construction, to which finned-tube radiation heaters will be attached.
  - 2. Method of attaching finned-tube radiation heaters to building structure.
  - 3. Penetrations of fire-rated wall and floor assemblies.
- C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HOT-WATER FINNED-TUBE RADIATION HEATERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following:
  - 1. Sterling HVAC Products; a Mestek company.
  - 2. Vulcan Radiator; a Master Company.
- B. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."
- C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled.
  - 1. Refer to schedules on Drawings for finned-tube radiation heater details
- D. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.
- E. Front Panel: Minimum 0.0528-inch-thick steel.
- F. Floor-Mounted Pedestals: Conceal insulated piping at maximum 36-inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel. Provide stainless-steel escutcheon for floor openings at pedestals.
- G. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element. Provide alternate cradle to allow the return pipe to run below the element.
- H. Finish: Baked-enamel finish in manufacturer's custom color as selected by Architect.
- I. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.
- J. Enclosure Style: Flat top.
- K. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of finned-tube radiation heaters.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 FINNED-TUBE RADIATION HEATER INSTALLATION

- A. Install units level and plumb.
- B. Install enclosure continuously around corners, using outside and inside corner fittings.
- C. Join sections with splice plates and filler pieces to provide continuous enclosure.
- D. Install access doors for access to valves.
- E. Install enclosure continuously from wall to wall.
- F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.
- G. Install valves within reach of access door provided in enclosure.
- H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.
- I. Install piping within pedestals for freestanding units.

#### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water finned-tube radiation heaters and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
  - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Section 230923.11 "Control Valves."
- D. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.

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3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 238239.13 – CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cabinet unit heaters with centrifugal fans and hot-water coils.
- B. For motor requirements refer to Section 230513 “Common Motor Requirements for HVAC Equipment.”

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. DDC: Direct digital control.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.

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2. Structural members to which cabinet unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
  - a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.

C. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Modine Manufacturing Company.
  2. Sterling; a Mestek Company.
  3. Trane.

#### 2.2 DESCRIPTION

- A. Factory-assembled and -tested unit complying with AHRI 440.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 2021.

#### 2.3 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

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- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

## 2.4 COIL SECTION INSULATION

- A. Insulation Materials: ASTM C 1071; surfaces exposed to airstream shall have aluminum-foil facing to prevent erosion of glass fibers.
  - 1. Thickness: 1/2 inch.
  - 2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
  - 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
  - 4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
  - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

## 2.5 CABINETS

- A. Material: Steel with baked-enamel finish with manufacturer's custom paint, in color selected by Architect.
  - 1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch-thick galvanized sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
  - 2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch-thick galvanized sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
  - 3. Recessed Flanges: Steel, finished to match cabinet.
  - 4. Base: Minimum 0.0528-inch-thick steel, finished to match cabinet, 4 inches high with leveling bolts.
  - 5. Extended Piping Compartment: 8-inch-wide piping end pocket.
  - 6. False Back: Minimum 0.0428-inch-thick steel, finished to match cabinet.

## 2.6 FILTERS

- A. Minimum Arrestance: And a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
  - 1. Pleated: 90 percent arrestance and MERV 7.

## 2.7 COILS

- A. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.



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2.8 CONTROLS

- A. Control devices are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
- B. Operational control sequences are indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Section 230548.13 "Vibration Controls for HVAC."
- C. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Comply with safety requirements in UL 1995.
- E. Unless otherwise indicated, install union and ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

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- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. The General Contractor shall engage a testing agent to perform the following tests and inspections:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Train University's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Provide one hour of training for each unit installed.

END OF SECTION

SECTION 238316 – RADIANT-HEATING HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes radiant-heating piping, including:
  - 1. PEX pipe and fittings
  - 2. Distribution manifolds
  - 3. Piping specialties

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PEX: Crosslinked polyethylene.
- C. PTFE: Polytetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. On data submittal sheets where more than one product is described, clearly annotate which product(s) is to be supplied.
  - 1. Include data for piping, fittings, manifolds, specialties, and controls; include pressure and temperature ratings, oxygen-barrier performance, fire-performance characteristics, and water-flow and pressure-drop characteristics.
- C. Shop Drawings: Show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.
  - 1. Shop Drawing Scale: 1/8-inch = 1 foot.
- D. Delegated Design Submittal: Working plans, drawn to scale, for tubing installation including tubing layout, spacing, and attachment details at a minimum scale of 1/8” = 1’-0”. Drawings shall indicate total length of each loop and shall include manifold locations and identifiers. Where more than one manifold is at a given location, clearly indicate which tubing loops are

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connected to each manifold. Provide supporting calculations for tubing layout which shall include heating capacity, water flow rate in gpm, and water pressure drop for each loop.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which radiant-heating piping will be attached.
  - 3. Perimeter moldings.
  - 4. Flooring structure and system.
  - 5. Wall construction.
  - 6. Piping and ductwork.
  - 7. Radiant manifold location, sizes and access doors.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For radiant-heating piping valves and equipment to include in operation and maintenance manuals.
- C. Photographs of tubing prior to pouring slab, with adequate details for future coordination. Submit one hard copy of photographs in 3-ring binder along with one CD containing all photographs. Each photograph shall have a separate designation and submission (paper and digital) shall include building plan with location and direction of each photograph indicated.

1.7 COORDINATION

- A. Coordinate layout and installation of radiant heating piping and suspension system with building and structural components.
- B. Coordinate size and location of access panels to allow access to manifolds concealed in walls.
- C. Coordinate thickening of slabs where required for adequate encasement of radiant heating piping components.
- D. Revise locations and elevations from those indicated as required to sit field conditions and ensure integrity of piping and as approved by Architect.

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1.8 PERFORMANCE REQUIREMENTS

- A. Delegated Tubing Layout Design: Design radiant heating tubing layout using manifold locations indicated on drawings and complying with the scheduled values for each space indicated on the “Radiant Floor Heating Schedule” including minimum heating capacity, number of loops, water flow rates, and maximum allowable water pressure drop.
- B. Radiant tubing layout drawings and supporting calculations shall be approved by the Architect prior to the start of tubing installation.
- C. Radiant tubing layout shall comply with the following tubing installation requirements:
  - 1. Radiant tubing shall be a minimum of 6-inches and a maximum of 12-inches from walls, fixed casework or other obstructions.
  - 2. Radiant tubing shall not cross within concrete slab.
  - 3. Radiant tubing turning radius shall be a minimum of 6-inches but not greater than 12-inches.
  - 4. Radiant tubing shall not cross under walls, neither stud partitions nor masonry walls, unless specifically noted otherwise on plans.
  - 5. Radiant tubing shall not be installed under the following items:
    - a. Floor mounted plumbing fixtures such as water closets and mop receptors.
    - b. Floor mounted mechanical equipment or concrete housekeeping pads.
    - c. Fixed casework or equipment.
    - d. Floor mounted kitchen appliances such as dishwashers.
    - e. Structural load bearing columns.
    - f. Stair stringers or supports.
  - 6. Radiant tubing loops shall run parallel to exterior walls within 8 feet of exterior wall. Radiant heating supply end of radiant loop shall run nearest to exterior wall.
  - 7. Individual radiant tubing loops shall have a maximum length of 300 feet - manifold connection to manifold connection.
  - 8. Maximum loop pressure drop shall be 10 ft wc overall, including tubing, manifold, and accessories.
  - 9. Radiant tubing loops serving the same space shall be equivalent in lengths with a tolerance of +/- 10% maximum.
  - 10. Install radiant heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels or walls.
  - 11. Maximum allowable surface temperature in occupied spaces shall be 80 deg F.

PART 2 - PRODUCTS

2.1 PEX PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. REHAU.
  - 2. Uponor.
  - 3. Watts Radiant, Inc.; a division of Watts Water Technologies, Inc.

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4. Wirsbo Co.

- B. Pipe Material: PEX plastic according to ASTM F 876.
- C. Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.10 mg per cu. m/day at according to DIN 4726.
- D. Fittings: ASTM F 1807, metal insert and copper crimp rings.
- E. Pressure/Temperature Rating: Minimum and .
- F. Warranty: Provide 25 year warranty on tubing.

2.2 DISTRIBUTION MANIFOLDS

- A. Manifold: Minimum , stainless steel, bronze, brass, copper Type L, or stainless steel with main shutoff and balancing valves. Manifold shall be provided from manufacturer
- B. Mounting Brackets: Copper, or copper-clad steel, where in contact with manifold.
- C. Identification Plate: Valve plate shall identify room served and loop number. If more than one loop serves a room, provide identification plates on manifolds to identify rooms served.
- D. Manifold Balancing Valves: Provide balancing valve with flow readout gauge in gallons per minute for each loop.
- E. Control Valves: Refer to Division 23 Section "Control Valves."

2.3 PIPING SPECIALTIES

- A. Cable Ties:
  - 1. Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
  - 2. Minimum Width: .
  - 3. Tensile Strength: , minimum.
  - 4. Temperature Range: .
- B. Expansion Stripping: Flexible joint to protect wall from concrete, allow expansion, and reduce sound transmission.

2.4 CONTROLS

- A. Temperature-control devices are specified in Section 230923.27 "Temperature Instruments."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces and substrates to receive radiant-heating piping for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Ensure that surfaces and pipes in contact with radiant-heating piping are free of burrs and sharp protrusions.
  - 2. Ensure that surfaces and substrates are level and plumb.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Install the following types of radiant-heating piping for the applications described:
  - 1. Piping in Interior Reinforced-Concrete Floors: PEX with oxygen barrier.

### 3.3 INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings or coordination drawings.
- B. Refer to radiant tubing installation notes on Drawings for layout restrictions, maximum loop length, and maximum allowable loop pressure drop.
- C. Install radiant-heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.
- D. Connect radiant piping to manifold in a reverse-return arrangement.
- E. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.
- F. Install manifolds in accessible locations, or install access panels to provide maintenance access as required in Section 083113 "Access Doors and Frames."
- G. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties" for pipes and connections to hydronic systems.
- H. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials according to Section 078413 "Penetration Firestopping."
- I. Piping in Interior Reinforced-Concrete Floors:
  - 1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.

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2. Space cable ties a maximum of o.c. and at center of turns or bends.
  3. Maintain minimum cover.
  4. Install a sleeve of thick, foam-type insulation or PE pipe around tubing and extending for a minimum of on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
  5. Maintain minimum 100-psig pressure with either air or water in piping during concrete placement and continue for 24 hours after placement.
  6. When installing tubing, start in a sequential order (normally from outside in) holding back tubing 6 inches or more from edge of slab. Loop lengths are labeled for each run and shall be installed accordingly. Run piping form manifold without joints.
  7. After each loop is installed, mark the ends with loop number and record actual loop length by reading footages indicated on the tubing.
  8. Use pipe sleeves to bring the tube ends out of the slab in a neat and orderly fashion as indicted.
  9. To avoid any hot spots at the manifold, supply and return lines within walls shall be insulated.
  10. Document tubing installation with photos prior to the placement of concrete and incorporate them into the Operation of Maintenance Manuals. Include "points of Reference" in each photograph so that the location of tubing can be located later.
  11. Where tubing passes under partition walls, take precautions to avoid puncture with penetrations by protecting tubing with sleeve or deeper "tubing-in-slab" installation.
  12. Notify all trades that radiant heat is installed in the floors and that no holes are to be drilled without prior notification and approval of the Architect.
  13. Installation shall comply with manufacturer's recommendations.
- J. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Architect.
- K. After system balancing has been completed, mark balancing valves to permanently indicate final position.
- L. Perform the following adjustments before operating the system:
1. Open valves to fully open position.
  2. Check operation of automatic valves.
  3. Set temperature controls so all zones call for full flow.
  4. Purge air from piping.
- M. After concrete has cured as recommended by concrete supplier, operate radiant-heating system as follows:
1. Start system heating at a maximum of above the ambient radiant-panel temperature and increase each following day until design temperature is achieved.
  2. For freeze protection, operate at a minimum of supply-water temperature.

### 3.4 FIELD QUALITY CONTROL

- A. Prepare radiant-heating piping for testing as follows:
1. Open all isolation valves and close bypass valves.



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2. Open and verify operation of zone control valves.
  3. Flush PEX with clean water and clean strainers.
  4. Flush steel and copper piping prior to filling radiant piping.
- B. The General Contractor shall engage a testing agent to perform the following tests and inspections:
1. Leak Test: After installation, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than . After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Repair leaks and retest until no leaks exist. Repair leaks and retest until no leaks exist.
  2. Inspection of Radiant Tubing: Architect shall inspect the installation and placement of radiant tubing before pouring concrete slab and during the pouring of the concrete slab. Manufacturer's representative shall also perform an inspection when the system is put into operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Radiant-heating piping will be considered defective if it does not pass tests and inspections. Remove and replace malfunctioning radiant heating piping components that do not pass tests, and retest as specified above.
- D. Prepare test and inspection reports.
- E. Protect hydronic piping system from damage during construction.

### 3.5 COMMISSIONING

- A. Fill system and perform initial chemical treatment. Check expansion tank to determine that they are not air bound and that system is completely full of water. Before operating system, open valves to fully open position. Close coil bypass valves. Remove and clean strainers. Set automatic fill valves for required system pressure. Check air vents and determine if all are operating freely (automatic type) or bleed air completely (manual type). Check operation of automatic valves.

END OF SECTION

## SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Requirements generally applicable to all electrical Work on the Project, including but not limited to Work specified in Divisions 26, 27, and 28.

#### 1.2 REFERENCES

##### A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. BMS: Building management system.
14. CAD: Computer-aided design or drafting.
15. CATV: Community antenna television.
16. CB: Circuit breaker.
17. cd: Candela, the SI fundamental unit of luminous intensity.
18. CO/ALR: Copper-aluminum, revised.
19. COPS: Critical operations power system.
20. CU or Cu: Copper.
21. CU-AL or AL-CU: Copper-aluminum.
22. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
23. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
24. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
25. dBm: Decibel absolute power with respect to 1 mW.
26. DC or dc: Direct current.
27. DCOA: Designated critical operations area.
28. DDC: Direct digital control (HVAC).
29. EGC: Equipment grounding conductor.
30. ELV: Extra-low voltage.

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- 31. EMF: Electromotive force.
- 32. EMI: Electromagnetic interference.
- 33. EMP: Electrical maintenance program (operation and maintenance); electromagnetic pulse (transient analysis).
- 34. EPS: Emergency power supply.
- 35. EPSS: Emergency power supply system.
- 36. ESS: Energy storage system.
- 37. EV: Electric vehicle.
- 38. EVPE: Electric vehicle power export equipment.
- 39. EVSE: Electric vehicle supply equipment.
- 40. FACU: Fire-alarm control unit.
- 41. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
- 42. FLC: Full-load current.
- 43. ft: Foot.
- 44. ft-cd: Foot-candle, the antiquated U.S. standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" when the SI unit candela (cd) replaced the international candle; see "fc."
- 45. FTP: File transfer protocol.
- 46. GEC: Grounding electrode conductor.
- 47. GFCI: Ground-fault circuit interrupter.
- 48. GFPE: Ground-fault protection of equipment.
- 49. GND: Ground.
- 50. HACR: Heating, air conditioning, and refrigeration.
- 51. HDPE: High-density polyethylene.
- 52. HID: High-intensity discharge.
- 53. HP or hp: Horsepower.
- 54. HVAC: Heating, ventilating, and air conditioning.
- 55. Hz: Hertz.
- 56. IBT: Intersystem bonding termination.
- 57. ICT: Information and communications technology.
- 58. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
- 59. I/O: Input/output.
- 60. IP: Ingress protection rating (enclosures); Internet protocol (communications).
- 61. IR: Infrared.
- 62. IS: Intrinsically safe.
- 63. IT&R: Inspecting, testing, and repair.
- 64. ITE: Information technology equipment.
- 65. kAIC: Kiloampere interrupting capacity.
- 66. kmil or MCM: One thousand circular mils.
- 67. kV: Kilovolt.
- 68. kVA: Kilovolt-ampere.
- 69. kvar: Kilovolt-ampere reactive.
- 70. kW: Kilowatt.
- 71. kWh: Kilowatt-hour.
- 72. LAN: Local area network.
- 73. lb: Pound (weight).
- 74. lbf: Pound (force).

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- 75. LCD: Liquid-crystal display.
- 76. LCDI: Leakage-current detector-interrupter.
- 77. LED: Light-emitting diode.
- 78. Li-ion: Lithium-ion.
- 79. lm: Lumen, the SI-derived unit of luminous flux.
- 80. LNG: Liquefied natural gas.
- 81. LP-Gas: Liquefied petroleum gas.
- 82. LRC: Locked-rotor current.
- 83. LV: Low voltage.
- 84. lx: Lux, the SI-derived unit of illuminance equal to one lumen per square meter.
- 85. m: Meter.
- 86. MCC: Motor-control center.
- 87. MDC: Modular data center.
- 88. MG set: Motor-generator set.
- 89. MIDI: Musical instrument digital interface.
- 90. MLO: Main lugs only.
- 91. MPEG-2: Abbreviation for the ISO/IEC Moving Picture Experts Group's standard for generic coding of moving pictures and associated audio information (ISO/IEC 13818) released in 1995 and used for most over-the-air and satellite broadcast digital television.
- 92. MPEG-4: Abbreviation for the ISO/IEC Moving Picture Experts Group's standard framework for coding of audio-visual objects (ISO/IEC 14496) released in 1999, with digital rights management and more advanced compression algorithms than MPEG-2.
- 93. MOV: Metal-oxide varistor.
- 94. MV: Medium voltage.
- 95. MVA: Megavolt-ampere.
- 96. mW: Milliwatt.
- 97. MW: Megawatt.
- 98. MWh: Megawatt-hour.
- 99. N.C.: Normally closed.
- 100. Ni-Cd: Nickel-cadmium.
- 101. Ni-MH: Nickel-metal hydride.
- 102. NIU: Network interface unit.
- 103. N.O.: Normally open.
- 104. NPT: National (American) standard pipe taper.
- 105. OCPD: Overcurrent protective device.
- 106. ONT: Optical network terminal.
- 107. PC: Personal computer.
- 108. PCS: Power conversion system.
- 109. PCU: Power-conditioning unit.
- 110. PF or pf: Power factor.
- 111. PHEV: Plug-in hybrid electric vehicle.
- 112. PLC: Programmable logic controller.
- 113. PLFA: Power-limited fire alarm.
- 114. PoE: Power over Ethernet.
- 115. POTS: Plain old telephone service. See "public switched telephone network" definition.
- 116. PSTN: Public switched telephone network.
- 117. PV: Photovoltaic.
- 118. PVC: Polyvinyl chloride.
- 119. pW: Picowatt.
- 120. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
- 121. RMS or rms: Root-mean-square.

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122. RPM or rpm: Revolutions per minute.
123. SCADA: Supervisory control and data acquisition.
124. SCCR: Short-circuit current rating.
125. SCR: Silicon-controlled rectifier.
126. SPD: Surge protective device.
127. sq.: Square.
128. SWD: Switching duty.
129. TCP/IP: Transmission Control Protocol/Internet Protocol.
130. TEFC: Totally enclosed fan-cooled.
131. TR: Tamper resistant.
132. TVSS: Transient voltage surge suppressor.
133. UL: (standards) UL Standards & Engagement Inc.; (product categories) UL, LLC.
134. UL CCN: UL Category Control Number.
135. UPS: Uninterruptible power supply.
136. USB: Universal serial bus.
137. UV: Ultraviolet.
138. V: Volt, unit of electromotive force.
139. V(ac): Volt, alternating current.
140. V(dc): Volt, direct current.
141. VA: Volt-ampere, unit of complex electrical power.
142. VAR: Volt-ampere reactive, unit of reactive electrical power.
143. VFC: Variable-frequency controller.
144. VOM: Volt-ohm-multimeter.
145. VoIP: Voice over Internet Protocol.
146. VPN: Virtual private network.
147. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
148. W: Watt, unit of real electrical power.
149. WAN: Wide area network.
150. Wh: Watt-hour, unit of electrical energy usage.
151. WPT: Wireless power transfer.
152. WPTE: Wireless power transfer equipment.
153. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit (thin wall).
7. EPEC-A: Type A electrical HDPE underground conduit.
8. EPEC-B: Type B electrical HDPE underground conduit.
9. ERMC: Electrical rigid metal conduit.
10. ERMC-A: Aluminum electrical rigid metal conduit.
11. ERMC-S: Steel electrical rigid metal conduit.
12. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
13. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
14. ERMC-SS: Stainless steel electrical rigid metal conduit.
15. FMC: Flexible metal conduit.

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16. FMC-A: Aluminum flexible metal conduit.
17. FMC-S: Steel flexible metal conduit.
18. FMT: Steel flexible metallic tubing.
19. FNMC: Flexible nonmetallic conduit. See "LFNC."
20. HDPE: HDPE underground conduit (thick wall).
21. HDPE-40: Schedule 40 HDPE underground conduit.
22. HDPE-80: Schedule 80 HDPE underground conduit.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERM-C-S-G.
38. RMC: See ERM-C.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.

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16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground HDPE conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.

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- 66. THHW: Thermoplastic, heat- and moisture-resistant cable.
- 67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
- 68. TW: Thermoplastic, moisture-resistant cable.
- 69. UF: Underground feeder and branch-circuit cable.
- 70. USE: Underground service-entrance cable.
- 71. XHH: Cross-linked polyethylene, heat-resistant cable.
- 72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

- 1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
  - a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.
- 2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
- 3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
- 4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
- 5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
- 6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
- 7. Conduit: A structure containing one or more duct raceways.
- 8. Designated Seismic System: An architectural, electrical, or mechanical system and its components for which the component importance factor is greater than 1.0 when determined in accordance with Section 018123 "Facility Seismic and Wind Criteria."
- 9. Direct Buried: Installed underground without encasement in concrete or other protective material.
- 10. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.
- 11. Duct Raceway: A single enclosed raceway for conductors or cable.
- 12. Electrical Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- 13. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:



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- a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
- b. Concrete Box: A box intended for use in poured concrete.
- c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
- d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
- e. Cover Plate: A cover designed for protecting wiring devices installed in flush-mounted device boxes while permitting their safe operation; also called a faceplate or wallplate.
- f. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
- g. Device Box: A box with provisions for mounting a wiring device directly to the box.
- h. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
- i. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
- j. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
- k. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
- l. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
- m. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
- n. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
- o. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
- p. Raised-Floor Box: A floor box intended for use in raised floors.
- q. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
- r. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
- s. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
- t. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.

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- u. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
14. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
  15. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.
    - a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
  16. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
  17. Jacket: A continuous nonmetallic outer covering for conductors or cables.
  18. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
  19. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
  20. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
  21. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein. Also called "single-line diagram."
  22. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
  23. Protective Device: A device that senses when an abnormal current flow, abnormal voltage potential, or other abnormal electrical waveform exists and then disconnects the affected portion of the circuit from the system. Common protective devices include fuses, circuit breakers, relays, ground-fault circuit interrupters, and arc-fault circuit interrupters.
  24. Public Switched Telephone Network (PSTN): Analog telephone technology that uses twisted pair cables from a telephone-provider central office for the transmission medium. "PSTN" refers to the telephone network; "POTS" refers to the individual subscriber line.
  25. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
  26. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
  27. Sheath: A continuous metallic covering for conductors or cables.
  28. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.

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29. Voice over Internet Protocol (VoIP): Digital telephone packet technology that uses the internet for its transmission medium.
30. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
  - a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
  - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
  - c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
  - d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
  - e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
  - f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.
31. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

### 1.3 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
  1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of electrical service.
  2. Do not proceed with interruption of electrical service without Owner's written permission.
  3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
    - a. Exercising generators.
    - b. Emergency lighting.
    - c. Elevators.
    - d. Fire-alarm systems.
    - e. Security systems.

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1.4 PREINSTALLATION MEETINGS

- A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than 10 days after Notice to Proceed. Agenda topics include, but are not limited to, the following:
  - 1. Electrical installation schedule.
  - 2. Status of power system studies.
- B. Electronic Safety and Security Preconstruction Conference: Schedule conference with Architect and Owner not later than 10 days after Notice to Proceed. Agenda topics include, but are not limited to, the following:
  - 1. Installation schedule for security, fire-alarm, and other life-safety systems.
  - 2. Monitoring services work coordination and monitoring service requests.

1.5 SEQUENCING

- A. Conduct and submit results of power system studies before submitting product data and Shop Drawings for electrical equipment.

1.6 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Coordination Drawings for Ceiling Areas: Where indicated on drawings, provide reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which equipment and suspension systems will be attached.
  - 3. Size and location of access panels on ceilings.
  - 4. Elevation, size, and route of sprinkler piping.
  - 5. Elevation, size, and route of plumbing piping.
  - 6. Elevation, size, and route of ductwork.
  - 7. Elevation, size, and route of cable tray.
  - 8. Elevation, size, and route of conduit.
  - 9. Elevation and size of wall-mounted and ceiling-mounted equipment.
  - 10. Access panels.
  - 11. Sprinklers.
  - 12. Air inlets and outlets.
  - 13. Control modules.
  - 14. Luminaires.
  - 15. Communications devices.
  - 16. Speakers.
  - 17. Security devices.
  - 18. Fire-alarm devices.
  - 19. Indicate clear dimensions for maintenance access in front of equipment.

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20. Indicate dimensions of fully open access doors.
- C. Coordination Drawings for Conduit and Cable Tray Routing: Routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
  3. Equipment racks.
  4. Light fixtures.
  5. Architectural elements.
- D. Coordination Drawings for Large Equipment Indoor Installations:
1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.
  2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
    - a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.
    - b. If freight elevator must be used, indicate width and height of door and depth of car. Indicate if large equipment must be tipped to use elevator.
    - c. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.
  3. Reflected ceiling plans for entry floor and floor where equipment is located, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
    - a. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
    - b. Location of lighting fixtures, sprinkler piping and sprinklers, ducts and diffusers, and other obstructions, indicating available overhead clearance.
    - c. Dimensioned working clearances and dedicated areas above and around electrical equipment where foreign systems and equipment are prohibited.
- E. Coordination Drawings for Large Equipment Outdoor Installations:
1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
    - a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
    - b. Indicate clear dimensions for fence gates and wall openings.
    - c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.

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- d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
- e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
- f. Dimensioned working clearances and dedicated areas around electrical equipment.

1.7 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
  - 1. Submission of power system studies.
  - 2. Submission of specified coordination drawings.
  - 3. Submission of action submittals specified in Division 26.
  - 4. Orders placed for major electrical equipment.
  - 5. Arrival of major electrical equipment on-site.
  - 6. Preinstallation meetings specified in Division 26.
  - 7. Utility service outages.
  - 8. Utility service inspection and activation.
  - 9. Mockup reviews.
  - 10. Closing of walls and ceilings containing electrical Work.
  - 11. System startup, testing, and commissioning activities for major electrical equipment.
  - 12. System startup, testing, and commissioning activities for emergency lighting.
  - 13. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
  - 14. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
  - 15. Requests for special inspections.
  - 16. Requests for inspections by authorities having jurisdiction.
- C. Installation Schedule for Communications Systems: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for installation of the communications Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
  - 1. Submission of specified coordination drawings.
  - 2. Submission of action submittals specified in Division 27.
  - 3. Orders placed for major equipment.
  - 4. Arrival of major equipment on-site.
  - 5. Preinstallation meetings specified in Division 27.
  - 6. Telephone and internet service outages.
  - 7. Telephone and internet service inspection and activation.
  - 8. Mockup reviews.
  - 9. Closing of walls and ceilings containing the communications Work.
  - 10. System startup, testing, and commissioning activities for communications equipment.

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11. System startup, testing, and commissioning activities for the Work specified in other divisions that depends on the Work specified in Division 27.
  12. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
  13. Requests for special inspections.
  14. Requests for inspections by authorities having jurisdiction.
- D. Installation Schedule for Security, Fire-Alarm, and Other Life-Safety Systems: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for installation of security, fire-alarm, and the other life-safety Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
1. Submission of specified coordination drawings.
  2. Submission of action submittals specified in Division 28.
  3. Orders placed for major equipment.
  4. Arrival of major equipment on-site.
  5. Preinstallation meetings specified in Division 28.
  6. Security and fire-alarm system outages.
  7. Security and fire-alarm system inspection and activation.
  8. Mockup reviews.
  9. Closing of walls and ceilings containing the security and fire-alarm Work.
  10. System startup, testing, and commissioning activities for security and fire-alarm equipment.
  11. System startup, testing, and commissioning activities for fire-alarm interfaces with the Work specified in other divisions.
  12. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
  13. Requests for special inspections.
  14. Requests for inspections by authorities having jurisdiction.

1.8 CLOSEOUT SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Operation and Maintenance Data:
1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device.
  2. Include the following information:
    - a. Manufacturer's operating specifications.
    - b. User's guides for software and hardware.
    - c. Schedule of maintenance material items recommended to be stored at the Project site.
    - d. Detailed instructions covering operation under both normal and abnormal conditions.
    - e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
    - f. List of load-current and overload-relay heaters with related motor nameplate data.

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- g. List of lamp types and photoelectric relays used on the Project, with ANSI and manufacturers' codes.
  - h. Manufacturer's instructions for setting field-adjustable components.
  - i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
  - j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.
  - k. Exterior pole inspection and repair procedures.
- C. Software and Firmware Operational Documentation: Provide software and firmware operational documentation, including the following:
  - 1. Software operating and upgrade manuals.
  - 2. Names, versions, and website addresses for locations of installed software.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.
  - 5. Testing and adjusting of panic and emergency power features.
  - 6. For lighting controls, include the following:
    - a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
    - b. Operation of adjustable zone controls.

## PART 2 - PRODUCTS

### 2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

- A. Substitution requests for electrical equipment will be entertained under the following conditions:
  - 1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with the Project performance requirements while significantly increasing value for Owner throughout life of facility.

### 2.2 SUBSTITUTION LIMITATIONS FOR COMMUNICATIONS EQUIPMENT

- A. Substitution requests for communications equipment will be entertained under the following conditions:
  - 1. Substitution requests may be submitted for consideration prior to the Communications Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with the Project performance requirements while significantly increasing value for Owner throughout life of facility.



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2.3 SUBSTITUTION LIMITATIONS FOR ELECTRONIC SAFETY AND SECURITY EQUIPMENT

- A. Substitution requests for electronic safety and security equipment will be entertained under the following conditions:
  - 1. Substitution requests may be submitted for consideration prior to the Electronic Safety and Security Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with the Project performance requirements while significantly increasing value for Owner throughout life of facility.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of electrical Work on the Project. Consult Architect for resolution of conflicting requirements.

3.2 CLOSEOUT ACTIVITIES

- A. Training:
  - 1. With assistance from factory-authorized service representatives, train Owner's maintenance personnel:

END OF SECTION

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SECTION 260513 – MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cables.
2. Connectors.
3. Solid terminations.
4. Separable insulated connectors.
5. Splice kits.
6. Medium-voltage tapes.
7. Arc-proofing materials.
8. Fault indicators.

1.2 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.
- C. Samples: 16 inch lengths for each type of cable specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Coordination Drawings: Indicate location of each cable, splice, and termination.
- C. Material Certificates: For each type of cable and accessory.
- D. Design Data: Cable pulling calculations, including conduit size and fill percentage, pulling tensions, cable sidewall pressure, jam probability, voltage drop, and ground wire sizing for each cable.
- E. Source quality-control reports.
- F. Field quality-control reports.

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PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with IEEE C2 and NFPA 70.
- C. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.2 CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. General Cable; Prysmian Group North America.
  - 2. Hendrix Wire and Cable; Marmon Holdings, Inc.; Berkshire Hathaway Inc.
  - 3. Kerite Power Cable; Marmon Holdings, Inc.; Berkshire Hathaway Inc.
  - 4. Okonite Company (The).
  - 5. Prysmian Cables and Systems; Prysmian Group North America.
  - 6. Southwire Company, LLC.
- B. Cable Type: Type MV 105.
- C. Conductor Insulation: Ethylene-propylene rubber.
  - 1. Voltage Rating: 15 kV.
  - 2. Insulation Thickness: 133 percent insulation level.
- D. Conductor: Aluminum.
- E. Comply with UL 1072, AEIC CS8, ICEA S-93-639/NEMA WC 74 and ICEA S-97-682.
- F. Conductor Stranding: Compact round, concentric lay, Class B.
- G. Shielding: Copper tape or solid copper wires, helically applied over semiconducting insulation shield.
- H. Three-Conductor Cable Assembly: Three insulated, shielded conductors cabled together with ground conductors.
  - 1. Circuit Identification: Color-coded tape (black, red, blue) under the metallic shielding.
- I. Cable Jacket: Sunlight-resistant PVC.

## 2.3 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. 3M.
  2. ABB, Electrification Business.
  3. DSG-Canusa; Shawcor Ltd.
  4. Eaton.
  5. G&W Electric Company.
  6. TE Connectivity Ltd.
- B. Comply with ANSI C119.4 for connectors between aluminum conductors or for connections between aluminum to copper conductors.
- C. Copper-Conductor Connectors: Aluminum barrel crimped connectors.

## 2.4 SOLID TERMINATIONS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. 3M.
  2. ABB, Electrification Business.
  3. DSG-Canusa; Shawcor Ltd.
  4. G&W Electric Company.
  5. Shawflex; Shawcor Ltd.
  6. TE Connectivity Ltd.
- B. Multiconductor Cable Sheath Seals: Type recommended by seal manufacturer for type of cable and installation conditions, including orientation.
1. Cold-shrink sheath seal kit with preformed sleeve openings sized for cable and insulated conductors.
  2. Heat-shrink sheath seal kit with phase- and ground-conductor re-jacketing tubes, cable-end sealing boot, and sealing plugs for unused ground-wire openings in boot.
  3. Cast-epoxy-resin sheath seal kit with wraparound mold and packaged, two-part, epoxy-resin casting material.
- C. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class shall be equivalent to that of cable. Include shield ground strap for shielded cable terminations.
1. Class 1 Terminations:
    - a. Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone-rubber, insulator modules; shield ground strap; and compression-type connector.
    - b. Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
    - c. Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.

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- d. Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.
2. Class 2 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, and compression-type connector. Include silicone-rubber tape; cold-shrink-rubber sleeve; or heat-shrink, plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.
3. Class 3 Terminations: Kit with stress cone and compression-type connector.

## 2.5 SEPERABLE INSULATED CONNECTORS

- A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. 3M.
  2. ABB (Electrification Products Division).
  3. Adalet.
  4. DSG-Canusa.
  5. Eaton.
  6. Engineered Products Company.
  7. G&W Electric Company.
  8. MP Husky USA Cable Tray & Cable Bus.
  9. nVent (Raychem).
  10. Scott Fetzer Co. (The).
  11. TE Connectivity Ltd.
- C. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.
- D. Load-Break Cable Terminators: Elbow-type units with 200 A load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
- E. Dead-Break Cable Terminators: Elbow-type unit with 200 A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
- F. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless steel mounting brackets, and attaching hardware.
  1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
  2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.

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3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
  4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.
- G. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

## 2.6 SPLICE KITS

- A. Description: For connecting medium voltage cables; type as recommended by cable or splicing kit manufacturer for the application.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. 3M.
  2. ABB, Electrification Business.
  3. DSG-Canusa; Shawcor Ltd.
  4. Eaton.
  5. Richards Manufacturing Co.
  6. TE Connectivity Ltd.
- C. Standard: Comply with IEEE 404.
- D. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, materials, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.
1. Combination tape and cold-shrink-rubber sleeve kit with re-jacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.
  2. Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket.
  3. Premolded, cold-shrink-rubber, in-line splicing kit.
  4. Premolded, EPDM splicing body kit with cable joint sealed by interference fit of mating parts and cable.
  5. Separable multiway splice system with all components for the required splice configuration.

## 2.7 MEDIUM-VOLTAGE TAPES

- A. Description: Electrical grade, insulating tape rated for medium voltage application.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. 3M.
  2. HellermannTyton.
  3. Scapa Industrial; Scapa Group plc.

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- C. Ethylene/propylene rubber-based, 30 mil splicing tape, rated for 130 deg C operation. Minimum 3/4 inch wide.

## 2.8 ARC-PROOFING MATERIALS

- A. Description: Fire retardant, providing arc flash protection.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. 3M.
- C. Tape for First Course on Metal Objects: 10 mil thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.
- D. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch thick, and compatible with cable jacket.
- E. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1 inch wide.

## 2.9 SOURCE QUALITY CONTROL

- A. Test and inspect cables according to ICEA S-97-682 before shipping.
- B. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install cables according to IEEE 576.
- B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inch on the pull rope.
  - 1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
  - 2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.
- C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

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1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.
  2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
  3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
  4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- F. Install "buried-cable" warning tape 12 inch above cables.
- G. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.
- H. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.
- I. Install cable splices at pull points and elsewhere as indicated; use standard kits. Use dead-front separable watertight connectors in manholes, and other locations subject to water infiltration.
- J. Install terminations at ends of conductors, and seal multiconductor cable ends with standard kits.
- K. Install separable insulated-connector components as follows:
1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
  2. Portable Feed-Through Accessory: At each terminal junction, with one on each terminal.
  3. Standoff Insulator: At each terminal junction, with one on each terminal.
- L. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:
1. Clean cable sheath.
  2. Wrap metallic cable components with 10 mil pipe-wrapping tape.
  3. Smooth surface contours with electrical insulation putty.
  4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
  5. Band arc-proofing tape with two layers of 1 inch wide half-lapped, adhesive, glass-cloth tape at each end of the arc-proof tape.
- M. Seal around cables passing through fire-rated elements according to Section 078413 "Penetration Firestopping."
- N. Ground shields of shielded cable at one point only. Maintain shield continuity and connections to metal connection hardware at all connection points.



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- O. Identify cables according to Section 260553 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

- 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
- 2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
- 3. Perform direct-current High Potential test of each new conductor according to NETA ATS, Ch. 7.3.3. Do not exceed cable manufacturer's recommended maximum test voltage.
- 4. Perform Partial Discharge test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
- 5. Perform Dissipation Factor test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.

- B. Medium-voltage cables will be considered defective if they do not pass tests and inspections.

- C. Prepare test and inspection reports.

END OF SECTION

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Connectors and splices.
4. Fire alarm wiring and cable.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

1.2 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Product Data: For each type of product.
- C. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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1. [Alpha Wire Company.](#)
2. [American Bare Conductor.](#)
3. [Belden Inc.](#)
4. [Cerro Wire LLC.](#)
5. [Encore Wire Corporation.](#)
6. [General Cable; Prysmian Group North America.](#)
7. [Okonite Company \(The\).](#)
8. [Service Wire Co.](#)
9. [Southwire Company, LLC.](#)
10. [WESCO.](#)

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
3. Type THHN and Type THWN-2: Comply with UL 83.
4. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
5. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. [AFC Cable Systems; Atkore International.](#)
2. [Alpha Wire Company.](#)
3. [American Bare Conductor.](#)
4. [Belden Inc.](#)
5. [Encore Wire Corporation.](#)
6. [General Cable; Prysmian Group North America.](#)
7. [Okonite Company \(The\).](#)
8. [Service Wire Co.](#)
9. [Southwire Company, LLC.](#)
10. [WESCO.](#)

C. Standards:

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1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  2. Comply with UL 1569.
  3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
1. Single circuit with color-coded conductors.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
1. Type TFN/THHN/THWN-2: Comply with UL 83.
  2. Type XHHW-2: Comply with UL 44.
- H. Armor: Steel, interlocked.

## 2.3 FIRE-ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Allied Wire & Cable Inc.
  2. CommScope, Inc.
  3. Comtran Corporation.
  4. Genesis; Resideo Technologies, Inc.
  5. PYROTENAX; brand of nVent Electrical plc.
  6. Prysmian Cables and Systems; Prysmian Group North America.
  7. Radix Wire.
  8. Rockbestos-Suprenant Cable Corp.
  9. Superior Essex Inc.; subsidiary of LS Corp.
  10. West Penn Wire; brand of Belden, Inc.
  11. Cerro Wire LLC.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than size as recommended by system manufacturer.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
  2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

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2.4 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. 3M Electrical Products.
  - 2. ABB, Electrification Business.
  - 3. AFC Cable Systems; Atkore International.
  - 4. Gardner Bender.
  - 5. Hubbell Utility Solutions; Hubbell Incorporated.
  - 6. Ideal Industries, Inc.
  - 7. ILSCO.
  - 8. NSi Industries LLC.
  - 9. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - 10. Service Wire Co.
  - 11. TE Connectivity Ltd.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
  - 1. Material: Copper.
  - 2. Type: Two hole with long barrels.
  - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Service Entrance:
  - 1. Copper.
- B. Feeders:
  - 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits:
  - 1. Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- D. ASD Output Circuits Cable: Extra-flexible stranded for all sizes.

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3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway.
- B. Feeders: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway.
- C. Exposed Branch Circuits: Type THHN/THWN-2, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or MC-Cable.

3.3 INSTALLATION, GENERAL

- A. Conceal cables within conduits in finished walls and drywall. Provide cables within conduits above accessible ceilings, unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- F. Use a maximum length of six feet of MC-Cable for fixture whips and connections to mechanical equipment.

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 260529 "Hangers and Supports for Electrical Systems."
  - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
  - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
    - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.

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3. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.
- D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

### 3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of existing floor, roof, and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.8 FIRESTOPPING

- A. Provide firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### 3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test conductors feeding the following critical equipment and services for compliance with requirements:
    - a. Emergency lighting.
    - b. Fire alarm.
    - c. Electronic security systems.
  - 2. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
  - 3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.



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- a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

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SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6a balanced twisted pair cable.
2. Balanced twisted pair cable hardware.
3. Twin-axial data highway cable.
4. RS-485 cable.
5. Control cable.
6. Control-circuit conductors.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Source quality-control reports.
- C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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- B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
  - 1. Flame Travel Distance: 60 inch or less.
  - 2. Peak Optical Smoke Density: 0.5 or less.
  - 3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.2 CATEGORY 6a BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500 MHz.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. 3M.
  - 2. AMP NETCONNECT; a TE Connectivity Ltd. company.
  - 3. Belden, Inc.
  - 4. Berk-Tek Leviton; a Nexans/Leviton alliance.
  - 5. CommScope, Inc.
  - 6. General Cable; Prysmian Group North America.
  - 7. Genesis Cable Products; Honeywell International, Inc.
  - 8. Hitachi Cable America Inc.
  - 9. Mohawk; a division of Belden Networking, Inc.
  - 10. Prysmian Cables and Systems; Prysmian Group North America.
  - 11. Superior Essex Inc.; subsidiary of LS Corp.
  - 12. SYSTIMAX Solutions; a CommScope Inc. brand.
- C. Standard: Comply with TIA-568-C.2 for Category 6a cables.
- D. Conductors: 100 ohm, No. 23 AWG solid copper.
  - 1. Lead Content: Less than 300 parts per million.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: Yellow thermoplastic.

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2.3 BALANCED TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. 3M.
  2. American Technology Systems Industries, Inc.
  3. AMP NETCONNECT; a TE Connectivity Ltd. company.
  4. Belden, Inc.
  5. Berk-Tek Leviton; a Nexans/Leviton alliance.
  6. CommScope, Inc.
  7. Dynacom Corporation.
  8. General Cable; Prysmian Group North America.
  9. Genesis Cable Products; Honeywell International, Inc.
  10. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  11. KRONE Incorporated.
  12. Leviton Manufacturing Co., Inc.
  13. Mohawk; a division of Belden Networking, Inc.
  14. Molex Premise Networks.
  15. Panduit Corp.
  16. Prysmian Cables and Systems; Prysmian Group North America.
  17. Simon Co. (The).
  18. Superior Essex Inc.; subsidiary of LS Corp.
  19. SYSTIMAX Solutions; a CommScope Inc. brand.
- C. General Requirements for Balanced Twisted Pair Cable Hardware:
1. Comply with the performance requirements of Category 6a.
  2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
  3. Cables must be terminated with connecting hardware of same category or higher.
- D. Source Limitations: Obtain balanced twisted pair cable hardware from single source from single manufacturer.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
1. Features:
    - a. Universal T568A and T568B wiring labels.
    - b. Labeling areas adjacent to conductors.
    - c. Replaceable connectors.
    - d. 48 ports.

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2. Construction: 16-gauge steel and mountable on 19 inch equipment racks.
  3. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- G. Patch Cords: Factory-made, four-pair cables in lengths indicated; terminated with an eight-position modular plug at each end.
1. Patch cords must have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords must have latch guards to protect against snagging.
  2. Patch cords must have color-coded boots for circuit identification.
- H. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.
  2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
  3. Marked to indicate transmission performance.
- I. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.
  2. Designed to snap-in to a patch panel or faceplate.
  3. Standards:
    - a. Category 6a, unshielded balanced twisted pair cable must comply with IEC 60603-7-41.
  4. Marked to indicate transmission performance.
- J. Faceplate:
1. Two, Four, and Six port, as indicated, vertical single-gang faceplates designed to mount to single-gang wall boxes.
  2. Faceplate: Thermoplastic, complying with requirements in Section 262726 "Wiring Devices."
  3. For use with snap-in jacks accommodating any combination of balanced twisted pair and coaxial work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
- K. Legend:
1. Machine printed, in the field, using adhesive-tape label.
  2. Snap-in, clear-label covers and machine-printed paper inserts.

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2.4 RS-232 CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Allied Wire & Cable Inc.
2. Belden Inc.
3. General Cable; Prysmian Group North America.
4. Genesis Cable Products; Honeywell International, Inc.
5. Southwire Company, LLC.

- B. PVC-Jacketed, TIA 232-F:

1. Nine, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Lead Content: Less than 300 parts per million.
3. Polypropylene insulation.
4. Aluminum foil-polyester tape shield with 100 percent shield coverage.
5. PVC jacket.
6. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
7. NFPA 70 Type: Type CM.
8. Flame Resistance: Comply with UL 1581.

- C. Plenum-Type, TIA 232-F:

1. Nine, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Lead Content: Less than 300 parts per million.
3. PE insulation.
4. Aluminum foil-polyester tape shield with 100 percent shield coverage.
5. Fluorinated ethylene propylene jacket.
6. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
7. Flame Resistance: Comply with NFPA 262.

2.5 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CMG.

1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.
6. Lead Content: Less than 300 parts per million.

- B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.

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5. Flame Resistance: NFPA 262.
6. Lead Content: Less than 300 parts per million.

2.6 CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.
6. Lead Content: Less than 300 parts per million.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.
6. Lead Content: Less than 300 parts per million.

2.7 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Encore Wire Corporation.
2. General Cable; Prysmian Group North America.
3. Service Wire Co.
4. Southwire Company, LLC.

B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

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2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
  - 1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
  - 1. Outlet boxes for telecommunications wiring must be no smaller than 4-11/16 inch square by 2-1/8 inch deep. Boxes must be provided with extension rings sized to bring edge of ring to within 1/8 inch of the finished wall surface.
  - 2. Flexible metal conduit must not be used.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows.
- D. Raceway Installation in Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
  - 2. Provide cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard if entering the room from overhead.
  - 4. Provide conduits 48 inches above finished floor.
  - 5. Provide metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.



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B. General Requirements for Cabling:

1. Install cables in raceways.
  - a. Finished spaces: conduit.
  - b. Concealed, non-accessible; conduit.
  - c. Concealed, accessible; conduit, cable tray, j-hook.
2. Comply with TIA-568-C Series of standards.
3. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
4. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
5. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
6. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
7. Secure and support cables at intervals not exceeding 30 inch and not more than 6 inch from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
11. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
12. Support: Provide independent support as indicated. Do not allow cables to lie on removable ceiling tiles.
13. Provide and fasten securely in place with hardware specifically designed and installed so as to not damage cables.
14. Provide strain relief.
15. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
16. Ground wire must be copper, and grounding methods must comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Provide termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Provide wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.

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3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Provide cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable must not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment must be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inch.
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inch.
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inch.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment must be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inch.
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inch.
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inch.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures must be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inch.
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inch.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inch.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inch.

### 3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

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1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.5 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.6 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers must use label stocks, laminating adhesives, and inks complying with UL 969.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.

3.8 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
  2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
    - a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy

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specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

- B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Grounding (earthing) electrodes.
9. Grounding electrode enclosures.

#### 1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 010000 "Administrative Provisions" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Shop Drawings: Plans showing dimensioned locations of grounding features described in "Field Quality Control for Grounding and Bonding of Electrical Power" Article, including the following:
1. Grounding electrode access enclosures.
  2. Grounding electrodes.
  3. Grounding arrangements and connections for separately derived systems.
  4. Interconnection with lighting protection system.
- D. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2 or THWN-2, copper or tinned-copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

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B. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ERICO; brand of nVent Electrical plc.
  - b. Harger Lightning & Grounding; business of Harger, Inc.
2. Referenced Standards: Complying with one or more of the following:
  - a. Soft or Annealed Copper Wire: ASTM B3.
  - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
  - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.

2.2 GROUNDING AND BONDING CLAMPS

- A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications.

B. Performance Criteria:

1. Regulatory Requirements:
  - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
  - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
  - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDER - Exothermically Welded Connection:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ABB, Electrification Business.
  - b. ALLTEC LLC.
  - c. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
  - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - e. ERICO; brand of nVent Electrical plc.
  - f. Harger Lightning & Grounding; business of Harger, Inc.
  - g. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.3 GROUNDING AND BONDING CONNECTORS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Listing Criteria:
    - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
    - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
- C. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ABB, Electrification Business.
    - b. Harger Lightning & Grounding; business of Harger, Inc.
    - c. ILSCO.
    - d. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- D. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ABB, Electrification Business.
    - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. ILSCO.
    - d. allG Fabrication (formerly ALT).
  - 2. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.
    - a. Tinned copper, C and H shaped.
- E. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ABB, Electrification Business.

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- b. [ERICO; brand of nVent Electrical plc.](#)
  - c. [Greaves Corp.; Essex Products Group, Inc.](#)
  - d. [allG Fabrication \(formerly ALT\).](#)
  - e. [Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.](#)
- 2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.
  - a. Tinned copper.

## 2.4 INTERSYSTEM BONDING BRIDGE GROUNDING CONNECTORS

- A. Description: Devices that provide means for connecting communications systems grounding and bonding conductors at service equipment or at disconnecting means for buildings or structures.
- B. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Listing Criteria:
    - a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
- C. UL KDSH - Two-Piece Intersystem Bonding Bridge Grounding Connector:
  - 1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. [Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.](#)
    - b. [Crouse-Hinds; brand of Eaton, Electrical Sector.](#)
    - c. [Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.](#)
  - 2. General Characteristics: Copper body and polycarbonate cover; four terminating points.

## 2.5 GROUNDING AND BONDING BUSBARS

- A. Description: Miscellaneous grounding and bonding devices that serve as common connection for multiple grounding and bonding conductors.
- B. Performance Criteria:
  - 1. Regulatory Requirements:



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- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Listing Criteria:
    - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- 2.6 GROUNDING (EARTHING) ELECTRODES
- A. Performance Criteria:
    - 1. Regulatory Requirements:
      - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
    - 2. Listing Criteria:
      - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
  - B. UL KDER - Rod Electrode:
    - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - a. ABB, Electrification Business.
      - b. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
      - c. ERICO; brand of nVent Electrical plc.
      - d. Galvan Industries, Inc.; Electrical Products Division, LLC.
      - e. Harger Lightning & Grounding; business of Harger, Inc.
      - f. allG Fabrication (formerly ALT).
    - 2. General Characteristics: Copper-clad steel; 3/4 inch by 10 ft.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.

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- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

### 3.2 SELECTION OF GROUNDING AND BONDING PRODUCTS

- A. Grounding and Bonding Conductors:
  - 1. Provide solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
- B. Grounding and Bonding Connectors:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Structural Steel: Welded connectors.
- C. Grounding and Bonding Busbars: Provide in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated on Drawings.

### 3.3 INSTALLATION OF GROUNDING AND BONDING

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
  - 1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
  - 2. Consult Designer for resolution of conflicting requirements.
- C. Special Techniques:
  - 1. Grounding and Bonding Conductors:
    - a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
    - b. Underground Grounding Conductors:
      - 1) Bury at least 30 inch below grade.
      - 2) Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.

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2. Grounding and Bonding Connectors: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - b. Make connections with clean, bare metal at points of contact.
  - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
  - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
  - f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
    - 1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
    - 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
    - 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.
  - g. Grounding and Bonding for Piping:
    - 1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
    - 2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
    - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
  - h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
3. Grounding and Bonding Busbars:
  - a. Install busbar horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
  - b. Where busbars are indicated on both sides of doorways, route bonding conductor up to top of door frame, across top of doorway, and down; connect to continuation of horizontal busbar.

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4. Electrodes:
  - a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.
    - 1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
    - 2) Use exothermic welds for below-grade connections.
  - b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.
  - c. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch deep, with cover.
    - 1) Install at least one test well for each service unless otherwise indicated. Install at ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
5. Grounding at Service:
  - a. Equipment grounding conductors and grounding electrode conductors must be connected to ground busbar. Install main bonding jumper between neutral and ground buses.
6. Grounding Underground Distribution System Components:
  - a. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.
  - b. Comply with IEEE C2 grounding requirements.
  - c. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch above to 6 inch below concrete. Seal floor opening with waterproof, nonshrink grout.
7. Equipment Grounding and Bonding:
  - a. Install insulated equipment grounding conductors with feeders and branch circuits.
  - b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
    - 1) Feeders and branch circuits.
    - 2) Lighting circuits.
    - 3) Receptacle circuits.
    - 4) Single-phase motor and appliance branch circuits.
    - 5) Flexible raceway runs.

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- c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- d. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- e. Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.

### 3.4 FIELD QUALITY CONTROL FOR GROUNDING AND BONDING

#### A. Tests and Inspections:

- 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
- 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
- 3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before conductors are connected.
  - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  - b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
  - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Designer promptly and include recommendations to reduce ground resistance.
- 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to record of tests and observations. Include number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

#### B. Nonconforming Work:

- 1. Grounding system will be considered defective if it does not pass tests and inspections.
- 2. Remove and replace defective components and retest.

#### C. Collect, assemble, and submit test and inspection reports.

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1. Report measured ground resistances that exceed the following values:
  - a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10  $\Omega$ .
  - b. Power Distribution Units or Panelboards Serving Electronic Equipment: 1  $\Omega$ .
  - c. Manhole Grounds: 10  $\Omega$ .

3.5 PROTECTION

- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Designer.

END OF SECTION

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

#### 1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 010000 "Administrative Provisions" and the individual sections specifying the work.

B. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
  - a. Slotted support systems, hardware, and accessories.
  - b. Clamps.
  - c. Hangers.
  - d. Sockets.
  - e. Eye nuts.
  - f. Fasteners.
  - g. Anchors.
  - h. Saddles.
  - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

## 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ABB, Electrification Business.
    - b. Allied Tube & Conduit; Atkore International.
    - c. CADDY; brand of nVent Electrical plc.
    - d. Cooper B-line; brand of Eaton, Electrical Sector.
    - e. Flex-Strut Inc.
    - f. G-Strut.
    - g. Gripple Inc.
    - h. Haydon Corporation.
    - i. MIRO Industries Inc.
    - j. Metal Ties Innovation.
    - k. Rocket Rack; Robroy Industries.
    - l. Unistrut; Atkore International.
    - m. Wesanco, Inc.
  2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  3. Material for Channel, Fittings, and Accessories: Galvanized steel.
  4. Channel Width: Selected for applicable load criteria.
  5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.
- D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:



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- 1) [Cooper B-line; brand of Eaton, Electrical Sector.](#)
  - 2) [Empire Industries, Inc.](#)
  - 3) [Hilti, Inc.](#)
  - 4) [ITW Ramset/Red Head; Illinois Tool Works, Inc.](#)
  - 5) [MKT Fastening, LLC.](#)
2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
  5. Toggle Bolts: All steel springhead type.
  6. Hanger Rods: Threaded steel.

### PART 3 - EXECUTION

#### 3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA NEIS 101
  2. NECA NEIS 102.
- B. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."
- C. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

#### 3.2 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT and ERMC may be supported by openings through structure members, in accordance with NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

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Minimum static design load used for strength determination must be weight of supported components plus 200 lb.

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. To Light Steel: Sheet metal screws.
  6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 PAINTING

- A. Touchup:
1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
    - a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
  2. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT duct raceways and elbows.
2. Type FMC duct raceways.
3. Type LFMC duct raceways.
4. Fittings for conduit, tubing, and cable.
5. Joint compounds.
6. Solvent cements.

B. Related Requirements:

1. Section 018116 "Facility Environmental Requirements" specifies temperature, humidity, acoustical, and other field conditions applicable to the Work specified in this Section.
2. Section 260010 "Supplemental Requirements for Electrical" specifies additional coordination, scheduling, sequencing, submittal, and installation requirements applicable to the Work for electrical, communications, and electronic safety and security systems on the Project, including wiring methods.
3. Section 078413 "Penetration Firestopping" specifies firestopping referenced by this Section.
4. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" specifies nonmetallic underground conduit with conductors (Type NUCC).
5. Section 260529 "Hangers and Supports for Electrical Systems" specifies conduit hangers and supports referenced by this Section.
6. Section 260543 "Underground Ducts and Raceways for Electrical Systems" specifies exterior duct banks, manholes, and underground utility construction.
7. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-S: Steel electrical metallic tubing.
3. ERMC: Electrical rigid metal conduit.
4. ERMC-S: Steel electrical rigid metal conduit.
5. FMC: Flexible metal conduit.
6. FMC-S: Steel flexible metal conduit.
7. LFMC: Liquidtight flexible metal conduit.
8. LFMC-S: Steel liquidtight flexible metal conduit.
9. PVC-40: Schedule 40 rigid PVC conduit.

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B. Definitions:

1. Conduit: A structure containing one or more duct raceways.
2. Direct Buried: Installed underground without encasement in concrete or other protective material.
3. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.
4. Duct Raceway: A single enclosed raceway for conductors or cable.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 010000 "Administrative Provisions" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 010000 "Administrative Provisions" and the individual sections specifying the work.
- B. Manufacturer's published instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 TYPE EMT DUCT RACEWAYS AND ELBOWS

- A. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Allied Tube & Conduit; Atkore International.
  - b. Calconduit; Atkore International.
  - c. Emerson Electric Co., Automation Solutions.
  - d. Picoma; Zekelman Industries.
  - e. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
  - f. Topaz Lighting & Electric.

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- g. [Western Tube; Zekelman Industries.](#)
  - h. [Wheatland Tube; Zekelman Industries.](#)
- 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. UL CCN FJMX; including UL 797.
- 3. Standard Features:
  - a. Material: Steel.
  - b. Exterior Coating: Zinc.
  - c. Interior Coating: Zinc.
  - d. Minimum Trade Size: Metric designator 16 (trade size 1/2).
- 4. Other Available Features Required by the Project:
  - a. Colors: As indicated on the Drawings.

2.3 TYPE ERM C DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERM C-S-G), Elbows, Couplings, and Nipples:

- 1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. [Allied Tube & Conduit; Atkore International.](#)
  - b. [Calconduit; Atkore International.](#)
  - c. [Crouse-Hinds; brand of Eaton, Electrical Sector.](#)
  - d. [Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.](#)
  - e. [Patriot Aluminum Products, LLC.](#)
  - f. [Republic Conduit; Nucor Corporation, Nucor Tubular Products.](#)
  - g. Rymco USA brand; manufactured and listed by subsidiary Conduit S.A. de C.V.
  - h. [Topaz Lighting & Electric.](#)
  - i. [Western Tube; Zekelman Industries.](#)
  - j. [Wheatland Tube; Zekelman Industries.](#)
- 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. UL CCN DYIX; including UL 6.
- 3. Standard Features:
  - a. Exterior Coating: Zinc.
  - b. Interior Coating: Zinc.
  - c. Minimum Trade Size: Metric designator 16 (trade size 1/2).

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2.4 TYPE FMC DUCT RACEWAYS

A. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ABB, Electrification Business.
  - b. Anaconda Sealtite; Anamet Electrical, Inc.
  - c. Electri-Flex Company.
  - d. International Metal Hose Co.
  - e. Penn Aluminum Conduit & EMT; Penn Aluminum International LLC; Berkshire Hathaway.
  - f. Topaz Lighting & Electric.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. UL CCN DXUZ; including UL 1.
3. Standard Features:
  - a. Material: Steel.
  - b. Minimum Trade Size: Metric designator 16 (trade size 1/2).
4. Other Available Features Required by the Project:
  - a. Colors: As indicated on the Drawings.

2.5 TYPE LFMC DUCT RACEWAYS

A. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ABB, Electrification Business.
  - b. Anaconda Sealtite; Anamet Electrical, Inc.
  - c. Electri-Flex Company.
  - d. International Metal Hose Co.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. UL CCN DXHR; including UL 360.
3. Standard Features:

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- a. Material: Steel.
  - b. Minimum Trade Size: Metric designator 16 (trade size 1/2).
4. Other Available Features Required by the Project:
- a. Colors: As indicated on the Drawings.

## 2.6 TYPE PVC DUCT RACEWAYS AND FITTINGS

### A. UL DZYZR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ABB, Electrification Business.
  - b. Calconduit; Atkore International.
  - c. JM Eagle.
  - d. NAPCO; Westlake Chemical Corp.
  - e. National Pipe and Plastic, Inc. (Oldcastle).
  - f. Opti-Com Manufacturing Network, Inc (OMNI).
  - g. Topaz Lighting & Electric.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. UL CCN DZYZR; including UL 651.
3. Standard Features:
  - a. Dimensional Specifications: Schedule 40.
  - b. Minimum Trade Size: Metric designator 16 (trade size 1/2).

## 2.7 FITTINGS FOR CONDUIT, TUBING, AND CABLE

### A. UL FKAV - Fittings for Type EMT Duct Raceways:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ABB, Electrification Business.
  - b. Allied Tube & Conduit; Atkore International.
  - c. Appleton; Emerson Electric Co., Automation Solutions.
  - d. Calconduit; Atkore International.
  - e. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

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- h. [Southwire Company, LLC.](#)
    - i. [Topaz Lighting & Electric.](#)
  - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
    - a. UL CCN FKAV; including UL 514B.
  - 3. Standard Features:
    - a. Material: Steel.
    - b. Coupling Method: Compression coupling.
    - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
- B. UL ILNR - Fittings for Type FMC Duct Raceways:
  - 1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. [American Fittings Corp. \(AMFICO\).](#)
    - b. [Liquid Tight Connector Co.](#)
    - c. [Southwire Company, LLC.](#)
  - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
    - a. UL CCN ILNR; including UL 514B.
- C. UL DXAS - Fittings for Type LFMC Duct Raceways:
  - 1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Arlington Industries, Inc.
    - b. [Liquid Tight Connector Co.](#)
  - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
    - a. UL CCN DXAS; including UL 514B.



## PART 3 - EXECUTION

### 3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturer's published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
  - 1. Exposed: ERM C.
  - 2. Concealed Aboveground: ERM C.
  - 3. Direct Buried: PVC-40.
  - 4. Concrete Encased in Trench: PVC-40.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFM C.
- C. Indoors:
  - 1. Exposed: EMT.
  - 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 3. Damp or Wet Locations: ERM C.
  - 4. Conduits must be concealed in finished spaces. Conduits on CLT may be exposed. See notes on drawings. Provide interior conduit coordination drawing. Provide underslab conduit coordination drawing.
- D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
  - 1. ERM C: Provide threaded-type fittings unless otherwise indicated.

### 3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
  - 1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.
  - 2. Electrical Safety: NFPA 70E.
  - 3. Commissioning of Active and Passive Fire Protection Features: NFPA 3 and NFPA 4.
  - 4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
  - 5. Communications Work: BICSI N1.
  - 6. Life Safety and Means of Egress Work: NFPA 101.
  - 7. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
  - 8. Work in Confined Spaces: NFPA 350.
  - 9. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
  - 10. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
  - 11. Type ERM C-S: Article 344 of NFPA 70 and NECA NEIS 101.
  - 12. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.

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13. Type LPMC: Article 350 of NFPA 70 and NECA NEIS 101.
14. Expansion Fittings: NEMA FB 2.40.
15. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

- a. Complete duct raceway installation before starting conductor installation.
- b. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
- c. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- d. Support conduit within 12 inch of enclosures to which attached.
- e. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
- f. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:
  - 1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2) Where an underground service duct raceway enters a building or structure.
  - 3) Conduit extending from interior to exterior of building.
  - 4) Conduit extending into pressurized duct raceway and equipment.
  - 5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6) Where otherwise required by NFPA 70.
- g. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
- h. Keep duct raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
- i. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
- j. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
- k. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
  - 1) Termination fittings with shoulders do not require two locknuts.
- l. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric

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designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

2. Types ERM C:
  - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
3. Types FMC, LFMC:
  - a. Provide a maximum of 72 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
4. Types PVC:
  - a. Do not install Type PVC, Type HDPE, or Type EPEC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
  - b. Comply with manufacturer's published instructions for solvent welding and fittings.
  - c. Join joints with solvent cement in accordance with manufacturer's published instructions and allowed to cure before handling. Joints to be bent, pushed, or pulled must set for minimum 24 h after joining.
5. Stub-ups to Above Recessed Ceilings:
  - a. Provide EMT for duct raceways.
  - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
6. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
  - a. EMT: Provide compression, fittings. Comply with NEMA FB 2.10.
  - b. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
7. Expansion-Joint Fittings:
  - a. Install in runs of aboveground ERM C and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
8. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.
  - a. Provide warning signs.

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D. Interfaces with Other Work:

1. Firestop penetrations of fire-rated floor and wall assemblies.
2. Provide conduit hangers and supports.

3.3 FIELD QUALITY CONTROL OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Conduit Placement:
  - a. Verify that center-line location and offsets are in accordance with the Drawings.
  - b. Verify that hangers and supports for conduits are attached to structure.
  - c. Verify that nuts on bolts or hanger rods are secure.
  - d. Verify that space between raceways and cored holes are filled with non-shrinking grout or other approved material indicated on the Drawings and the Specifications.
  - e. Verify that expansion devices are installed at locations indicated on the Drawings and the Specifications.
  - f. Verify that ends are cut square to provide flush-butting surfaces when spliced and inside edges are free of burrs that could impede installation of cables.
  - g. Verify minimum separation of utilities, or that approved mechanical protection has been provided to surrounding conduit(s) where minimum separation cannot be achieved.
3. Document all changes on Record Drawings.

B. Nonconforming Work:

1. Conduit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.4 CLEANING

- A. Verify that bentonite or other drilling fluids are contained and removed, and site is restored to its original or improved condition.

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.
4. Hoods for outlet boxes.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 010000 "Administrative Provisions" and the individual sections specifying the work.

B. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.
4. Hoods for outlet boxes.

1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 010000 "Administrative Provisions" and the individual sections specifying the work.

B. Manufacturers' Published Instructions:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.
4. Hoods for outlet boxes.

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PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ABB, Electrification Business.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Arlington Industries, Inc.
  - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - h. MonoSystems, Inc.
  - i. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - j. Pass & Seymour; Legrand North America, LLC.
  - k. Patriot Aluminum Products, LLC.
  - l. Plasti-Bond; Robroy Industries.
  - m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - n. Spring City Electrical Manufacturing Company.
  - o. Topaz Lighting & Electric.
  - p. Wiremold; Legrand North America, LLC.
3. Options:
  - a. Material: Cast metal.

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- b. Sheet Metal Depth: Minimum 1.5 inch.
- c. Cast-Metal Depth: Minimum 1.8 inch.
- d. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.

D. UL QCIT - Metallic Conduit Bodies:

- 1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
- 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ABB, Electrification Business.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - f. Pass & Seymour; Legrand North America, LLC.
  - g. Patriot Aluminum Products, LLC.
  - h. Plasti-Bond; Robroy Industries.
  - i. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - j. Topaz Lighting & Electric.

E. UL QCIT - Metallic Device Boxes:

- 1. Description: Box with provisions for mounting wiring device directly to box.
- 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ABB, Electrification Business.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Arlington Industries, Inc.
  - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - i. Patriot Aluminum Products, LLC.
  - j. Plasti-Bond; Robroy Industries.
  - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - l. Topaz Lighting & Electric.
- 3. Options:
  - a. Material: Cast metal.

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- b. Sheet Metal Depth: minimum 1.5 inch.
- c. Cast-Metal Depth: minimum 1.8 inch.

F. UL QCIT - Metallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ABB, Electrification Business.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Cooper B-line; brand of Eaton, Electrical Sector.
  - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - g. Pass & Seymour; Legrand North America, LLC.
  - h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - i. Topaz Lighting & Electric.

G. UL QCIT - Metallic Floor Boxes and Floor Box Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ABB, Electrification Business.
  - b. AFC Cable Systems; Atkore International.
  - c. Arlington Industries, Inc.
  - d. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - e. FSR Inc.
  - f. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - h. Leviton Manufacturing Co., Inc.
  - i. Pass & Seymour; Legrand North America, LLC.
  - j. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - k. Wiremold; Legrand North America, LLC.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. UL CCN QCIT; including UL 514A.
3. Standard Features: Box mounted in floor with floor box cover and other components to complete floor box enclosure.



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- a. Provide voltage barrier for power and communications.
- b. Provide metal cover flush with finished door.

## 2.2 JUNCTION BOXES AND PULL BOXES

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

### C. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Adalet.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Cooper B-line; brand of Eaton, Electrical Sector.
  - d. FSR Inc.
  - e. Hoffman; brand of nVent Electrical plc.
  - f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - h. Milbank Manufacturing Company.
  - i. N J Sullivan Company.
  - j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - l. Spring City Electrical Manufacturing Company.
  - m. Square D; Schneider Electric USA.

### 3. Options:

- a. Degree of Protection: Type 1.

### D. UL BGUZ - Indoor Cast-Metal Junction and Pull Boxes:

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1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Adalet.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
3. Options:
  - a. Degree of Protection: Type 1.

E. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Adalet.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Cooper B-line; brand of Eaton, Electrical Sector.
  - d. FSR Inc.
  - e. Hoffman; brand of nVent Electrical plc.
  - f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - h. Milbank Manufacturing Company.
  - i. N J Sullivan Company.
  - j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - l. Spring City Electrical Manufacturing Company.
  - m. Square D; Schneider Electric USA.
3. Options:
  - a. Degree of Protection: Type 3R.

F. UL BGUZ - Outdoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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- a. [Adalet.](#)
  - b. [Appleton; Emerson Electric Co., Automation Solutions.](#)
  - c. [Crouse-Hinds; brand of Eaton, Electrical Sector.](#)
  - d. [O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.](#)
3. Options:
- a. Degree of Protection: Type 3R.

2.3 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. [ABB, Electrification Business.](#)
  - b. [Appleton; Emerson Electric Co., Automation Solutions.](#)
  - c. [Arrow Hart, Wiring Devices; Eaton, Electrical Sector.](#)
  - d. [Crouse-Hinds; brand of Eaton, Electrical Sector.](#)
  - e. [Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.](#)
  - f. [Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.](#)
  - g. [Intermatic, Inc.](#)
  - h. [Leviton Manufacturing Co., Inc.](#)
  - i. [O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.](#)
  - j. [Panduit Corp.](#)
  - k. [Pass & Seymour; Legrand North America, LLC.](#)
  - l. [Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.](#)
  - m. [Topaz Lighting & Electric.](#)
  - n. [Wiremold; Legrand North America, LLC.](#)

2. Options:

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- a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
- b. Wallplate Material: 0.032 inch thick, color selected by Architect.

D. UL QCIT or QCMZ - Nonmetallic Cover Plates for Device Boxes:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ABB, Electrification Business.
  - b. Appleton; Emerson Electric Co., Automation Solutions.
  - c. Arlington Industries, Inc.
  - d. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - e. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - f. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - h. Intermatic, Inc.
  - i. Leviton Manufacturing Co., Inc.
  - j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - k. Panduit Corp.
  - l. Pass & Seymour; Legrand North America, LLC.
  - m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - n. Topaz Lighting & Electric.
  - o. Wiremold; Legrand North America, LLC.
- 2. Options:
  - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
  - b. Wallplate Material: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
  - c. Color: Color selected by architect.

2.4 HOODS FOR OUTLET BOXES

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. Listing Criteria:
  - a. UL CCN QCIT or UL CCN QCMZ; including UL 514D.
  - b. Receptacle, Hood, Cover Plate, Gaskets, and Seals: UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
- 3. Mounts to box using fasteners different from wiring device.

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B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT or QCMZ - Extra-Duty, While-in-Use Hoods for Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ABB, Electrification Business.
  - b. Allied Tube & Conduit; Atkore International.
  - c. Appleton; Emerson Electric Co., Automation Solutions.
  - d. Arlington Industries, Inc.
  - e. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - f. Intermatic, Inc.
  - g. Leviton Manufacturing Co., Inc.
  - h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Additional Characteristics: Marked "Extra-Duty" in accordance with UL 514D.
3. Options:
  - a. Provides clear, weatherproof, "while-in-use" cover.
  - b. Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shop Drawings: Prepare and submit the following:

1. Shop Drawings for Floor Boxes: Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness at location where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

3.2 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Designer for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:

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- a. Type 3R unless otherwise indicated.
  - b. Locations Exposed to Hosedown: Type 4.
  - c. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
2. Indoors:
- a. Type 1 unless otherwise indicated.
  - b. Damp or Dusty Locations: Type 2.
  - c. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
  - d. Locations Exposed to Hosedown: Type 4.

### 3.3 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
  2. Consult Designer for resolution of conflicting requirements.
- C. Special Installation Techniques:
1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
  2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
  3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
  4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
  5. Locate boxes so that cover or plate will not span different building finishes.
  6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
  7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
  8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
  9. Set metal floor boxes level and flush with finished floor surface.
  10. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
  11. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
    - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    - b. Provide gaskets for wallplates and covers.

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12. Identification: Provide labels for boxes and associated electrical equipment.

- a. Identify field-installed conductors, interconnecting wiring, and components.
- b. Provide warning signs.
- c. Label each box with engraved metal or laminated-plastic nameplate.

3.4 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.5 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Designer.

END OF SECTION

## SECTION 260533.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Surface metal raceways and fittings.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional coordination, scheduling, sequencing, submittal, and installation requirements applicable to the Work for electrical, communications, and electronic safety and security systems on the Project, including wiring methods.
2. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding referenced by this Section.
3. Section 260553 "Identification for Electrical Systems" specifies warning signs referenced by this Section.

#### 1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
1. Product data for sustainable design features for each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Manufacturer's published instructions.



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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 SURFACE METAL RACEWAYS AND FITTINGS

- A. UL RJBT - Surface Metal Raceways and Fittings with Metal Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - b. MonoSystems, Inc.
  - c. Wiremold; Legrand North America, LLC.
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. UL CCN RJBT; including UL 5.
3. Standard Features:
  - a. Aluminum base with snap-on covers.
  - b. Wiring Channels: Single and Dual. Multiple channels must be capable of housing a standard 20 to 30 A device flush within the raceway.
4. Sustainable Design Features:
  - a. Corporate Sustainability Report: Third-party verified corporate sustainability report is publicly available from manufacturer, which includes environmental impacts of extraction operations and activities associated with product and its supply chain.
  - b. Regional Materials (LEED): Provide documentation if product is sourced (extracted, manufactured, purchased) within 100 mi of the Project site.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.

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- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Electrical Safety: NFPA 70E.
3. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
4. Communications Work: BICSI N1.
5. Work in Confined Spaces: NFPA 350.
6. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
7. Surface Metal Raceway: Article 386 of NFPA 70.
8. Consult Architect for resolution of conflicting requirements.

- C. Special Installation Techniques:

1. Install surface raceways only where indicated on Drawings.
2. Install surface raceway with a minimum 2 inch radius control at bend points.
3. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's published instructions. Tape and glue are unacceptable support methods.

- D. Interfaces with Other Work:

1. Identification: Provide labels for surface raceways and associated electrical equipment.
  - a. Identify field-installed conductors, interconnecting wiring, and components.
  - b. Provide warning signs.
2. Paint to match adjacent surface where required.

### 3.2 FIELD QUALITY CONTROL OF SURFACE RACEWAYS

- A. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Perform tests and inspections recommended by standards listed in "Reference Standards for Installation" Paragraph.

- B. Nonconforming Work:

1. Boxes and covers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

- C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

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3.3 CLEANING

- A. Remove construction dust and debris from surface raceways before installing covers.

3.4 PROTECTION

- A. After installation, protect surface raceways from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

## SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Metal cable trays.
2. Cable tray accessories.

B. Products Installed, but Not Furnished, under This Section:

1. Section 078413 "Penetration Firestopping" specifies firestopping products installed under this Section.
2. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding products installed under this Section.
3. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

#### 1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. Metal cable trays.
2. Cable tray accessories.

C. Shop Drawings:

1. Cable tray fabrication drawings, diagrams, and supporting documents.

D. Field quality-control reports.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Manufacturers' published instructions.

C. Field Reports:

1. Factory test reports.
2. Manufacturer's field reports for field quality-control support.

## PART 2 - PRODUCTS

### 2.1 METAL CABLE TRAYS

- A. Description: This product category covers metal cable trays and metal cable tray systems intended for field assembly and for use in accordance with Article 392 of NFPA 70.
- B. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Listing Criteria: UL CCN CYNW; including NEMA VE 1 and suitability for use as equipment grounding conductors in accordance with Sections 392.60(A) and 392.60(B) of NFPA 70.
- C. UL CYNW - Ladder Cable Tray:
  - 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ABB, Electrification Business.
    - b. Cooper B-line; brand of Eaton, Electrical Sector.
    - c. Cope; Atkore International.
  - 2. Source Limitations: Obtain products from single manufacturer.
  - 3. General Characteristics:
    - a. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
    - b. Radius-Fitting Rung Spacing: 9 inch at center of tray's width.
    - c. Minimum Cable-Bearing Surface for Rungs: 7/8 inch width with radius edges.
    - d. No portion of the rungs must protrude below the bottom plane of side rails.
    - e. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200 lb. concentrated load, when tested in accordance with NEMA VE 1.
    - f. Splicing Assemblies: Bolted type using serrated flange locknuts.
    - g. Splice-Plate Capacity: Splices located within support span must not diminish rated loading capacity of cable tray.
  - 4. Materials and Finishes (Aluminum):
    - a. Materials: Alloy 6063-T6 in accordance with ANSI H35.1/H 35.1M for extruded components, and Alloy 5052-H32 or Alloy 6061-T6 in accordance with ANSI H35.1/H 35.1M for fabricated parts.
    - b. Hardware: Chromium-zinc-plated steel, ASTM F1136.

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5. Options:
  - a. Width: 12 inch unless otherwise indicated on Drawings.
  - b. Minimum Usable Load Depth: 4 inch.
  - c. Straight Section Lengths: 10 ft, except where shorter lengths are required to facilitate tray assembly.
  - d. Rung Spacing: 9 inch on center.
  - e. Fitting Minimum Radius: 12 inch.
  - f. Class Designation: Comply with NEMA VE 1, Class 12B.

D. UL CYNW - Wire-Mesh Cable Tray:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Cablofil; Legrand North America, LLC.
  - b. Cooper B-line; brand of Eaton, Electrical Sector.
  - c. Cope; Atkore International.
  - d. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. MonoSystems, Inc.
2. Source Limitations: Obtain products from single manufacturer.
3. General Characteristics:
  - a. Configuration: Galvanized-steel wire mesh, complying with NEMA VE 1.
  - b. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200 lb. concentrated load, when tested in accordance with NEMA VE 1.
  - c. Splicing Assemblies: Bolted type using serrated flange locknuts.
  - d. Splice-Plate Capacity: Splices located within support span must not diminish rated loading capacity of cable tray.
4. Materials and Finishes (Steel):
  - a. Straight Sections and Fittings: Steel complies with the minimum mechanical properties of ASTM A1011/A1011M, SS, Grade 33.
  - b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
  - c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
  - d. Finish:
    - 1) Hot-dip galvanized after fabrication, complying with ASTM A123/A123M, Class B2, with galvanized, ASTM B633 hardware.
5. Options:
  - a. Width: As indicated on Drawings.
  - b. Minimum Usable Load Depth: As indicated on Drawings.
  - c. Straight Section Lengths: 12 ft, except where shorter lengths are required to facilitate tray assembly.

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- d. Class Designation: Comply with NEMA VE 1, Class 12B.

2.2 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.3 SOURCE QUALITY CONTROL

- A. Product Data: Prepare and submit catalog cuts, brochures, diagrams, schedules, and performance data illustrating size, physical appearance, and other characteristics of product.
1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Shop Drawings: Prepare and submit the following for each cable tray system:
1. Cable Tray Fabrication Drawings, Diagrams, and Supporting Documents:
- a. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- b. Include load calculations to show that dead and live loads do not exceed manufacturer's rating for tray and its support elements.
- c. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
- 1) Vertical and horizontal offsets and transitions.
- 2) Clearances for access above and to sides of cable trays.
- 3) Vertical elevation of cable trays above the floor or bottom of ceiling structure.

3.2 INSTALLATION OF CABLE TRAYS

- A. Install cable tray and support systems in accordance with NEMA VE 2.

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- B. Install cable tray as a complete system, including fasteners, hold-down clips, support systems, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable tray, so that the tray is accessible for cable installation and splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure.
- G. Design fasteners and supports to carry cable tray, cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems."
- H. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- I. Support assembly to prevent twisting from eccentric loading.
- J. Do not install more than one cable tray splice between supports.
- K. Support trapeze hangers for wire-basket trays with 3/8 inch diameter rods.
- L. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed recommended dimensions. Space connectors and set gaps in accordance with applicable standard.
- M. Make changes in direction and elevation using manufacturer's recommended fittings.
- N. Make cable tray connections using manufacturer's recommended fittings.
- O. Seal penetrations through fire and smoke barriers. Provide re-enterable products.
- P. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- Q. Install cable trays with enough workspace to permit access for installing cables.
- R. Install warning signs in visible locations on or near cable trays after cable tray installation.

### 3.3 CABLE TRAY GROUNDING

- A. Ground cable trays in accordance with NFPA 70 unless additional grounding is specified.
- B. Bond cable trays to power source for cables contained within with bonding conductors sized in accordance with Article 250 of NFPA 70.



### 3.4 INSTALLATION OF CABLES

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inch.
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure must be no more than 72 inch.

### 3.5 FABRICATION OF CONNECTION POINTS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays in accordance with requirements in NEMA VE 2 and NEMA FG 1.

### 3.6 INSTALLATION OF CABLE TRAY MARKINGS AND SIGNS

- A. Ladder Cable Trays: Provide warning signs to prevent use as personnel ladder.
  - 1. Lettering: 1-1/2 inch high.
  - 2. Legend: "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

### 3.7 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
  - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
  - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
  - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that power circuits are not installed in cable trays.
  - 4. Verify that there are no intruding items, such as pipes, hangers, or other equipment, in the cable tray.
  - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.

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6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorqued in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1  $\Omega$ .

C. Nonconforming Work:

1. Cable tray will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.8 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and must remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

END OF SECTION

## SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Direct buried conduit, duct, and duct accessories.
2. Handholes and boxes for exterior underground wiring.
3. Manholes for exterior underground wiring.
4. Utility structure accessories.
5. Precast concrete transformer bases.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" specifies nonmetallic underground conduit with conductors (Type NUCC).

#### 1.2 DEFINITIONS

- A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.
- B. Duct Bank: Two or more ducts installed in parallel, direct buried or with additional casing materials such as concrete.
- C. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.
- D. Manhole: An underground chamber containing electrical cables and equipment, sized to provide access with working space clearances.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.
- F. GRC: Galvanized rigid (steel) conduit.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Coordination Meeting(s): For underground ducts and raceways. Conduct meeting(s) as videoconference or at Project site before installation of communications conduit.
1. Attendees: Installers, administrators for field tests and inspections, and Owner's telecommunications representatives. Notify Architect and Owner of scheduled meeting dates.

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1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include duct-bank materials, including spacers and miscellaneous components.
  - 2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 3. Include accessories for handholes, boxes, and other utility structures.
- C. Sustainable Design Product Data:
  - 1. **Product Data:** For solvents and adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.
- D. Shop Drawings:
  - 1. Precast or Factory-Fabricated Concrete Structures:
    - a. Include plans, elevations, sections, and details, including attachments to other Work.
    - b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
    - c. Include reinforcement details.
    - d. Include frame and cover design and manhole chimneys.
    - e. Include grounding details.
    - f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, sumps, and other accessories.
    - g. Include joint details.
  - 2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
    - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
    - b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
    - c. Include cover design.
    - d. Include grounding details.
    - e. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and other accessories.
  - 3. Transformer pad.
- E. Field quality-control reports.

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1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.
- C. Field Reports:
  - 1. Factory Test Reports: For handholes and boxes.
  - 2. Manufacturer's field reports for field quality-control support.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Electrical or Communications Service: Do not interrupt electrical or communications service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Notify Architect and Owner no fewer than five business days in advance of proposed interruption of electrical or communications service.
  - 2. Do not proceed with interruption of electrical or communications service without Owner's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 TYPE ERM-C-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

- A. Performance Criteria:
  - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - 2. General Characteristics: UL 6, UL CCN DYIX, ANSI C80.1, Schedule 40.

2.2 TYPE PVC RACEWAYS AND FITTINGS

- A. Performance Criteria:
  - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - 2. General Characteristics: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

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2.3 SOLVENT CEMENTS

A. Performance Criteria:

1. As recommended by conduit manufacturer.
2. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
3. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL CCN DWTT.
4. Sustainability Characteristics:
  - a. VOC Content: 510 g/L or less for PVC conduit and fittings.

B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 312000 "Earth Moving."

2.4 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 312000 "Earth Moving."

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
  - a. ASTM C858 for design and manufacturing processes.
  - b. SCTE 77, Tier 22.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover:

1. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or combination.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Armorcast Products Company; brand of Hubbell Utility Solutions; Hubbell Incorporated.
  - b. MacLean Highline.
  - c. NewBasis.
  - d. Oldcastle Infrastructure Inc.; CRH Americas.

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- e. [Quazite; brand of Hubbell Utility Solutions; Hubbell Incorporated.](#)
  - 3. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
  - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and installed location.
    - a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
    - b. Cover Legend: Molded lettering, "ELECTRIC" or "COMMUNICATIONS."
  - 5. Conduit Entrance Provisions: Conduit-terminating fittings must mate with entering ducts for secure, fixed installation in enclosure wall.
  - 6. Duct Entrance Provisions: Duct-terminating fittings must mate with entering duct for secure, fixed installation in enclosure wall.
  - 7. Handholes 12 inch wide by 24 inch long and larger must have factory-installed inserts for cable racks and pulling-in irons.
  - 8. Options:
    - a. Color: Gray or green.
- C. High-Density Polyethylene (HDPE) Boxes:
- 1. Description: Injection molded of HDPE or copolymer-polypropylene. Cover must be made of polymer concrete.
  - 2. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. [Nordic Fiberglass, Inc.](#)
    - b. [Oldcastle Infrastructure Inc.; CRH Americas.](#)
    - c. [PenCell Plastics; brand of Hubbell Utility Solutions; Hubbell Incorporated.](#)
    - d. [Quazite; brand of Hubbell Utility Solutions; Hubbell Incorporated.](#)
  - 3. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
  - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
    - a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
    - b. Cover Legend: Molded lettering, "ELECTRIC" or "COMMUNICATIONS."
  - 5. Duct Entrance Provisions: Duct-terminating fittings must be installed perpendicular to box wall and mate with entering duct for secure, fixed installation in enclosure wall without putting stress on box wall or fitting.
  - 6. Options:
    - a. Color: Gray or green.

2.6 MANHOLES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:

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1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
  - a. ASTM C858 for design and manufacturing processes.
  - b. SCTE 77.

B. Precast Concrete Manholes:

1. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Carder Concrete Products.
  - b. Elmhurst-Chicago Stone Co.
  - c. Oldcastle Infrastructure Inc.; CRH Americas.
  - d. Rinker Group, Ltd.
  - e. Riverton Concrete Products.
  - f. Smith-Midland Corporation.
  - g. Utility Concrete Products, LLC.
  - h. Utility Vault Co.
  - i. Wausau Tile, Inc.
3. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus additional 12 inch vertically and horizontally to accommodate alignment variations.
  - a. At locations indicated.
  - b. Knockout panels must be located no less than 6 inch from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
  - c. Knockout panel opening must have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
  - d. Knockout panel must be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
  - e. Knockout panels must be 1-1/2 to 2 inch thick.
4. Ground Rod Sleeve: Provide 3 inch PVC sleeve in manhole floors 2 inch from wall adjacent to, but not underneath, duct entering structure.
5. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at installation location with ground-water level at grade.
6. Source Quality Control: Test and inspect in accordance with ASTM C1037.

2.7 UTILITY STRUCTURE ACCESSORIES

- A. Description: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application



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- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
  - 1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A48/A48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, as indicated.
    - a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
    - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
  - 2. Cover Legend: Cast in; “ELECTRIC” or “COMMUNICATIONS.”  
Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
    - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C270, Type M, except for quantities less than 2.0 cu. ft where packaged mix complying with ASTM C387/C387M, Type M, may be used.
    - b. Seal joints watertight using preformed plastic or rubber complying with ASTM C990. Install sealing material in accordance with sealant manufacturers' published instructions.
- C. Manhole Sump Frame and Grate: ASTM A48/A48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2 inch diameter eye, and 1-by-4 inch bolt.
  - 1. Working Load Embedded in 6 inch (150 mm), 4000 psi (27.6 MPa) Concrete: 13,000 lbf minimum tension.
- E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4 inch diameter eye, rated 2500 lbf minimum tension.
- F. Pulling-in and Lifting Irons in Concrete Floors: 7/8 inch diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; fastened to reinforcing rod; and with exposed triangular opening.
  - 1. Ultimate Yield Strength: 40,000 lbf shear and 60,000 lbf tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2 inch ID by 2-3/4 inch deep, flared to 1-1/4 inch minimum at base.
  - 1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Ground Rod Sleeve: 3 inch PVC sleeve in manhole floors 2 inch from wall adjacent to, but not underneath, ducts routed from facility.
- I. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless steel expander clip with 1/2 inch bolt, 5300 lbf rated pullout strength, and minimum 6800 lbf rated shear strength.

## 2.8 DUCT SEALING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. ABB, Electrification Business.
  2. American Polywater Corporation.
  3. CommScope, Inc.
  4. Gardner Bender.
  5. Ideal Industries, Inc.
  6. NSi Industries LLC.
  7. TE Connectivity Ltd.
- B. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Compound must be capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Duct sealing compound must be removable without damaging ducts or cables.
- C. Inflatable Duct-Sealing System: Wraparound inflatable bladder that seals ducts that are empty or containing conductors against air and water infiltration. System is suitable for use in steel, plastic, or concrete ducts and penetrations.

## 2.9 TRANSFORMER PAD

- A. Precast concrete transformer pad and accessories in accordance with Central Maine Power's written requirements as indicated on Drawings.

## 2.10 SOURCE QUALITY CONTROL

- A. Factory Tests for Handholes and Boxes:
1. Factory Tests and Inspections: Perform the following tests and inspections on handholes and boxes, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, before delivering to site. Affix label with name and date of manufacturer's or qualified testing laboratory's certification of system compliance.
    - a. Precast Concrete Utility Structures: Test and inspect in accordance with ASTM C1037.
    - b. Polymer Concrete and Nonconcrete Handhole and Pull-Box Prototypes: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests must be for specified tier ratings of products supplied. Testing machine pressure gages must have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Architect if there is conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain in accordance with Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication in accordance with Section 311000 "Site Clearing."

### 3.2 SELECTION OF UNDERGROUND DUCTS

- A. Aboveground Conduit and Underground Vertical Conduit Bends; GRC, unless indicated otherwise.
- B. Duct for Electrical Cables More Than 600 V: PVC-40, direct buried unless otherwise indicated.
- C. Duct for Electrical Feeders 600 V and Less: PVC-40, direct buried unless otherwise indicated.
- D. Duct for Electrical Branch Circuits: PVC-40, direct buried unless otherwise indicated.

### 3.3 SELECTION OF UNDERGROUND ENCLOSURES

- A. Manholes, Handholes and Boxes:
  - 1. Communications Structures and Units in Roadways and Other Deliberate Traffic Paths: Precast concrete, AASHTO HB 17, H-20 structural load rating.
  - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 22 or High-density plastic, SCTE 77, Tier 22 structural load rating.
  - 3. Cover design load must not exceed load rating of handhole or box.

### 3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

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- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- D. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures in accordance with "Cutting and Patching" Article in Section 017300 "Execution."

### 3.5 INSTALLATION OF DUCTS AND DUCT BANKS

A. Reference Standards:

- 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
- 2. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

- 1. Slope: Pitch duct minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from high point between two manholes to drain in both directions.
- 2. Curves and Bends:
  - a. Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with minimum radius of 48 inch, both horizontally and vertically, at other locations unless otherwise indicated.
  - b. Field bending must be in accordance with NFPA 70 minimum radii requirements, except bends over 45 degrees must be made with minimum radius of 48 inch. Use only equipment specifically designed for material and size involved. Use PVC heating bender for bending PVC conduit.
- 3. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete for minimum of 12 inch on each side of coupling.
  - a. Install insulated grounding bushings on steel raceway terminations that are less than 12 inch below grade or floor level and do not terminate in hubs.
- 4. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inch o.c. for 5 inch duct, and vary proportionately for other duct sizes.
  - a. Begin change from regular spacing to end-bell spacing 10 ft from end bell, without reducing duct slope and without forming trap in line.
  - b. Grout end bells into structure walls from both sides to provide watertight entrances.
- 5. Building Wall Penetrations: Make transition from underground duct to steel raceway at least 10 ft outside building wall, without reducing duct line slope away from building and

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- without forming trap in line. Use fittings manufactured for transition to steel raceway type installed. Install steel raceway penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
6. Install manufactured steel raceway elbows for stub-ups at poles unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
    - a. Couple steel elbows to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete for minimum of 12 inch on each side of coupling.
  7. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15 psig hydrostatic pressure.
  8. Pulling Cord: Install 200 lbf test nylon cord in empty ducts.
  9. Concrete-Encased Ducts and Duct Bank:
    - a. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes 6 inch or less in nominal diameter.
    - b. Width: As indicated.
    - c. Depth: As indicated.
    - d. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
    - e. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 ft of duct. Place spacers within 24 inch of duct ends. Stagger spacers approximately 6 inch between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
    - f. Minimum Space between Ducts: 3 inch between edge of duct and exterior envelope wall, 2 inch between ducts for like services, and 4 inch between power and communications ducts.
    - g. Elbows:
      - 1) Use manufactured steel elbows for stub-ups and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
    - h. Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch from edge of equipment base.
      - 1) Stub-ups must terminate in coupling installed flush with finished floor and minimum 3 inch from conduit side to edge of slab.
    - i. Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch from edge of wall. Install insulated grounding bushings on terminations at equipment.
      - 1) Stub-ups must be minimum 4 inch above finished floor and no less than 3 inch from conduit side to edge of slab.

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- j. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  - k. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  - l. Concrete Cover: Install minimum of 3 inch of concrete cover between edge of duct to exterior envelope wall, 2 inch between duct of like services, and 4 inch between power and communications ducts.
  - m. Place minimum 6 inch of engineered fill above concrete encasement of duct.
  - n. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    - 1) Start at one end and finish at other, allowing for expansion and contraction of duct as its temperature changes during and after pour. Use expansion fittings installed in accordance with manufacturer's published instructions, or use other specific measures to prevent expansion-contraction damage.
    - 2) If more than one pour is necessary, terminate each pour in vertical plane and install 3/4 inch reinforcing-rod dowels extending minimum of 18 inch into concrete on both sides of joint near corners of envelope.
  - o. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.
10. Direct-Buried Duct and Duct Bank:
- a. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inch in nominal diameter.
  - b. Width: As indicated.
  - c. Depth: As indicated.
  - d. Set elevation of top of duct bank below frost line.
  - e. Place minimum 3 inch of sand as bed for duct. Place sand to minimum of 6 inch above top level of duct.
  - f. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  - g. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 ft of duct. Place spacers within 24 inch of duct ends. Stagger spacers approximately 6 inch between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - h. Install duct with minimum of 3 inch between ducts for like services and 6 inch between power and communications duct.

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- i. Install manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
    - 1) Couple RNC duct to steel raceway with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete.
    - 2) Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch from edge of base. Install insulated grounding bushings on terminations at equipment.
      - a) Stub-ups must terminate in coupling installed flush with finished base and minimum 3 inch from conduit side to edge of base.
    - 3) Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally on exterior of wall minimum of 60 inch from edge of wall. Install insulated grounding bushings on terminations at equipment.
    - 4) Stub-ups through interior floors must be minimum 4 inch above finished floor and no less than 3 inch from conduit side to edge of equipment pad or floor slab.
  - j. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inch over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
11. Underground-Line Warning Tape: Bury detectable underground line specified in Section 312000 "Earth Moving" no less than 12 inch above concrete-encased duct and duct banks and approximately 12 inch below grade. Align tape parallel to and within 3 inch of centerline of duct bank. Provide additional warning tape for each 12 inch increment of duct-bank width over nominal 18 inch. Space additional tapes 12 inch apart, horizontally across width of ducts.
  12. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

#### A. Reference Standards:

1. Precast Concrete Handholes: Comply with ASTM C891 unless otherwise indicated.
2. Consult Architect for resolution of conflicting requirements.

#### B. Special Techniques:

1. Precast Concrete Handholes and Manholes:

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- a. Install units level and plumb and with orientation and depth coordinated with connecting duct to minimize bends and deflections required for proper entrances.
  - b. Unless otherwise indicated, support units on level bed of crushed stone or gravel graded from 1 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
  - c. Field-cut openings for conduits in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
2. Elevations:
  - a. Manhole Roof: Install with rooftop at least 15 inch below finished grade.
  - b. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
  - c. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
  - d. Where indicated, cast handhole cover frame integrally with handhole structure.
3. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
4. Manhole Access: Circular opening in manhole roof; sized to match cover size.
  - a. Install chimney, constructed of precast concrete collars and rings, and cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight joints and waterproof grouting for frame and chimney.
5. Waterproofing: Apply waterproofing to exterior surfaces of manholes after concrete has cured at least three days. After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
6. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.
7. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inch for manholes and 2 inch for handholes, for anchor bolts installed in field. Use minimum of two anchors for each cable stanchion.
8. Ground manholes, handholes, and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

#### A. Special Techniques:

1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from 1/2 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.



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3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
4. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
5. Field cut openings for duct in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
6. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour concrete ring encircling, and in contact with enclosure entry, and with top surface screeded to top of box cover frame. Bottom of ring must rest on compacted earth.
  - a. Concrete: 3000 psi, 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with troweled finish.
  - b. Dimensions: As indicated.
7. Ground handholes and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
  2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12 inch long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
  3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Nonconforming Work:
  1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
  2. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

### 3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.

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1. Sweep floor, removing dirt and debris.
2. Remove foreign material.

END OF SECTION

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND  
CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve seal systems.
4. Grout.
5. Pourable sealants.
6. Foam sealants.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Product Data: For each type of product.

C. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

## PART 2 - PRODUCTS

### 2.1 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Advance Products & Systems, LLC.
  2. American Polywater Corporation.
  3. BWM Company.
  4. CALPICO, Inc.
  5. Flexicraft Industries.
  6. GPT; a division of EnPRO Industries.
  7. Metraflex Company (The).
  8. Proco Products, Inc.
  9. Roxtec Inc.
- B. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
- C. Options:
1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  2. Pressure Plates: Carbon steel.
  3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
1. Use metallic conduit or cast pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed.
  3. Provide sleeves for wall penetrations unless core-drilled holes or formed openings are used. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  4. Install sleeves for floor penetrations. Extend sleeves installed in floors 6 inch above finished floor level.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

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1. Use metal conduit sleeves.
  2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete or masonry walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components provide an index of nomenclature for electrical equipment and system components used in identification signs and labels.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

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- B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:
  - 1. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.
- C. Signs, labels, and tags required for personnel safety must comply with the following standards:
  - 1. Safety Colors: NEMA Z535.1.
  - 2. Facility Safety Signs: NEMA Z535.2.
  - 3. Safety Symbols: NEMA Z535.3.
  - 4. Product Safety Signs and Labels: NEMA Z535.4.
  - 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

## 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 1000 V or Less:
  - 1. Black letters on orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
  - 1. Color must be factory applied.
  - 2. Colors for 208Y/120 V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 480Y/277V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange
    - c. Phase C: Yellow.
  - 4. Color for Neutral: White.
  - 5. Color for Equipment Grounds: Green.

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C. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

D. Warning labels and signs must include, but are not limited to, the following legends:

1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."

E. Equipment Identification Labels:

1. Black letters on white field.

## 2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Brady Corporation.
  - b. Champion America.
  - c. emedco.
  - d. Grafoplast Wire Markers.
  - e. HellermannTyton.
  - f. LEM Products Inc.
  - g. Marking Services, Inc.
  - h. Panduit Corp.
  - i. Seton Identification Products; a Brady Corporation company.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Brady Corporation.
  - b. HellermannTyton.
  - c. Marking Services, Inc.
  - d. Panduit Corp.
  - e. Seton Identification Products; a Brady Corporation company.

C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.



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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. A'n D Cable Products.
    - b. Brady Corporation.
    - c. Brother International Corporation.
    - d. emedco.
    - e. Grafoplast Wire Markers.
    - f. Ideal Industries, Inc.
    - g. LEM Products Inc.
    - h. Marking Services, Inc.
    - i. Panduit Corp.
    - j. Seton Identification Products; a Brady Corporation company.
  2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
  3. Marking for Labels:
    - a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. A'n D Cable Products.
    - b. Brady Corporation.
    - c. Brother International Corporation.
    - d. emedco.
    - e. Grafoplast Wire Markers.
    - f. HellermannTyton.
    - g. Ideal Industries, Inc.
    - h. LEM Products Inc.
    - i. Marking Services, Inc.
    - j. Panduit Corp.
    - k. Seton Identification Products; a Brady Corporation company.
  2. Minimum Nominal Size:
    - a. 1-1/2 by 6 inch for raceway and conductors.
    - b. 3-1/2 by 5 inch for equipment.
    - c. As required by authorities having jurisdiction.

## 2.4 BANDS AND TUBES

- A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch long, with diameters sized to suit diameters and that stay in place by gripping action.

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Brady Corporation.
  - b. HellermannTyton.
  - c. Marking Services, Inc.
  - d. Panduit Corp.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Panduit Corp.

## 2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Carlton Industries, LP.
    - b. Champion America.
    - c. HellermannTyton.
    - d. Ideal Industries, Inc.
    - e. Marking Services, Inc.
    - f. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Marking Services, Inc.
- C. Floor Marking Tape: 2 inch wide, 5 mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Carlton Industries, LP.
  - b. Seton Identification Products; a Brady Corporation company.

2.6 TAGS

- A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Grafoplast Wire Markers.
    - e. LEM Products Inc.
    - f. Marking Services, Inc.
    - g. Panduit Corp.
    - h. Seton Identification Products; a Brady Corporation company.

2.7 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Marking Services, Inc.
    - e. Seton Identification Products; a Brady Corporation company.
  2. Engraved legend.
  3. Thickness:
    - a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
    - b. For signs larger than 20 sq. inch, 1/8 inch thick.
    - c. Engraved legend with black letters on white face.
    - d. Punched or drilled for mechanical fasteners with 1/4 inch grommets in corners for mounting.
    - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

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2.8 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. HellermannTyton.
  - 2. Ideal Industries, Inc.
  - 3. Marking Services, Inc.
  - 4. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black, except where used for color-coding.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location.
- B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

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- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on red background with minimum 3/8 inch high letters for emergency instructions at equipment used for emergency lighting.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- K. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
  - 1. "EMERGENCY POWER."
- L. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- M. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- O. Self-Adhesive Labels:
  - 1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.

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- P. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- T. Nonmetallic Preprinted Tags:
  - 1. Place in location with high visibility and accessibility.
  - 2. Secure using cable ties.
- U. Metal-Backed Butyrate Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
  - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.
- V. Laminated Acrylic or Melamine Plastic Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
  - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.
- W. Cable Ties: General purpose, for attaching tags, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

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1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:
  1. "EMERGENCY POWER."
  2. "POWER."
- E. Power-Circuit Conductor Identification, 1000 V or Less: For conductors in pull and junction boxes use self-adhesive wraparound labels snap-around labels to identify phase.
  1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, use self-adhesive labels with conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with conductor designation.
- H. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
  1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- I. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
  1. Apply to exterior of door, cover, or other access.
  2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Controls with external control power connections.
    - b. Control panels.
    - c. Telecommunications panels.
    - d. Security panels.
    - e. Lighting control panels.
    - f. Energy management control panels.
- L. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

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- M. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on red background with minimum 3/8 inch high letters for emergency instructions at equipment used for emergency operations.
- N. Equipment Identification Labels:
  - 1. Indoor Equipment: Engraved.
  - 2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Enclosed switches.
    - e. Enclosed circuit breakers.
    - f. Enclosed controllers.
    - g. Variable-speed controllers.
    - h. Push-button stations.
    - i. Contactors.
    - j. Remote-controlled switches, dimmer modules, and control devices.
    - k. Battery-inverter units.
    - l. Monitoring and control equipment.

END OF SECTION



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SECTION 260573 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Short-circuit study.
2. Overcurrent protective device coordination study.
3. Load-flow and voltage-drop study.
4. Motor-starting study.
5. Arc-flash hazard study.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For power system analysis software to be used for studies.

1. Product Certificates: For power system study software applications, include certificate stating compliance with specified requirements, signed by software manufacturer.

C. Power System Study Reports:

1. Submit reports after approval of system protective devices submittals. Submittals must be in digital form.
2. Submit short-circuit study input data, including completed computer-program input data sheets.
3. Submit coordination study input data, including completed computer-program input data sheets.
  - a. Submit load-flow, voltage-drop, and motor-starting data with coordination study.
4. Submit arc-flash study input data, including completed computer-program input data sheets.
5. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
6. Submit revised one-line diagram, reflecting field investigation results and results of short-

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circuit study.

- D. Data files for studies in format compatible with Owner's power system analysis software.
- E. Digital-twin models.

1.3 QUALITY ASSURANCE

- A. Submittals for power system studies must be signed and sealed by qualified electrical professional engineer responsible for their preparation.
- B. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.
- C. Software algorithms must comply with requirements of standards and guides specified in this Section.
- D. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Power Tools for Windows (PTW); brand of SKM Systems Analysis, Inc.
- B. Standard Features:
  - 1. Power System Analysis:
    - a. Power-systems-analysis software applications must have analytical capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 3002 series standards.
    - b. Computer software application must be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program must report device settings and ratings of overcurrent protective devices and must demonstrate selective coordination by computer-generated, time-current coordination plots.
    - c. Computer software application must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.
  - 2. Analysis Standards:
    - a. Short-Circuit Current Analysis: In accordance with IEEE 3002.3.
    - b. Device Coordination Analysis: In accordance with IEEE 3004.3 and IEEE 3004.5.
    - c. Load-Flow Analysis: In accordance with IEEE 3002.2.

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- d. Motor-Starting Analysis: In accordance with IEEE 3002.7.
  - e. Harmonic Analysis: In accordance with IEEE 3002.8.
  - f. Transient Stability Analysis: In accordance with IEEE P3002.9.
  - g. Arc-Flash Hazard Analysis: In accordance with IEEE 1584.
3. Capable of printing arc-flash hazard warnings for equipment on weather- and UV-resistant, pressure-sensitive adhesive labels complying with NFPA 70E.
- a. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard study:
    - 1) Equipment designation.
    - 2) Nominal voltage.
    - 3) Protection boundaries.
      - a) Arc-flash boundary.
      - b) Restricted approach boundary.
      - c) Limited approach boundary.
    - 4) Arc-flash PPE category.
    - 5) Required minimum arc rating of PPE in Cal/cm squared.
    - 6) Available incident energy.
    - 7) Working distance.
    - 8) Engineering report number, revision number, and issue date.

C. Other Available Features Required by the Project:

- 1. Simultaneous faults.
- 2. Explicit negative sequence.
- 3. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Collect and analyze data for power system studies.

- 1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
- 2. For equipment included as Work on the Project, use characteristics submitted under provisions of action submittals and information submittals for the Project.
- 3. For equipment that is existing to remain, obtain required.
- 4. Gather and tabulate required input data to support power system studies. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 3002 series standards as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

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- a. Product data for the Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
- b. Electrical power utility impedance at service.
- c. Power sources and ties.
- d. Short-circuit current at each system bus (three phase and line to ground).
- e. Full-load current of loads.
- f. Voltage level at each bus.
- g. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
- h. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
- i. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
- j. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
- k. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
- l. Maximum demands from service meters.
- m. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
- n. Motor horsepower and NEMA MG 1 code letter designation.
- o. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
- p. Medium-voltage cable sizes, lengths, conductor material, cable construction.
- q. Derating factors.

### 3.2 PREPARATION

#### A. Preparation of Data for Short-Circuit Study:

1. Verify completeness of data supplied on one-line diagram. Call discrepancies to Architect's attention.
2. For equipment included as Work on the Project, use characteristics submitted under provisions of action submittals and information submittals for the Project.
3. Prepare one-line diagram of modeled power system, showing the following:
  - a. Protective device designations and ampere ratings.
  - b. Conductor types, sizes, and lengths.
  - c. Transformer kVA and voltage ratings.
  - d. Motor and generator designations and kVA ratings.
  - e. Switchboard and panelboard designations and ratings.
  - f. Derating factors and environmental conditions.
  - g. Revisions to electrical equipment required by study.

#### B. Preparation of Data for Overcurrent Protective Device Coordination Study:

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1. Prepare data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, indicating the following:
  - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
  - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
  - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
  - d. Generator thermal-damage curve.
  - e. Ratings, types, and settings of utility company's overcurrent protective devices.
  - f. Special overcurrent protective device settings or types stipulated by utility company.
  - g. Time-current-characteristic curves of devices indicated to be coordinated.
  - h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
  - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
  - j. Switchboards and panelboards ampacity, and SCCR in amperes rms symmetrical.
  - k. Identify series-rated interrupting devices for condition where available fault current is greater than interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.
2. Examine the Project's overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
3. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

C. Preparation of Data for Arc-Flash Hazard Study:

1. Assemble data from short-circuit study and overcurrent protective device coordination study.
2. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.3 SHORT-CIRCUIT STUDY

- A. Base study on device characteristics supplied by device manufacturer.
- B. Extent of electrical power system to be studied is the electrical distribution system including MV components of this project.
- C. Begin short-circuit current analysis at service, extending down to system overcurrent protective devices as follows:

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1. To normal system low-voltage load buses where fault current is 5 kA or less.
  2. Exclude equipment supplied by single transformer smaller than 75 kVA.
- D. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for the Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- E. Include AC fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase AC systems. Also account for fault-current DC decrement to address asymmetrical requirements of interrupting equipment.
- F. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at equipment indicated on one-line diagram.
1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.
- G. Include in report identification of protective device applied outside its capacity.

3.4 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

- A. Base study on device characteristics supplied by device manufacturer.
- B. Extent of electrical power system to be studied is the electrical distribution system including MV components of this project.
- C. Begin analysis at service, extending down to system overcurrent protective devices as follows:
1. To normal system low-voltage load buses where fault current is 5 kA or less.
- D. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for the Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- E. Transformer Primary Overcurrent Protective Devices:
1. Device must not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads in accordance with IEEE C57.96 if required by unusual loading or emergency conditions.
  2. Device settings must protect transformers in accordance with IEEE C57.12.00, for fault currents.
- F. Motor Protection:
1. Select protection for low-voltage motors in accordance with IEEE 3004.8 and NFPA 70.
  2. Select protection for motors served at voltages more than 600 V in accordance with IEEE

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- G. Conductor Protection: Protect cables against damage from fault currents in accordance with ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 3004.7. Demonstrate that equipment withstands maximum short-circuit current for time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- H. Generator Protection: Select protection in accordance with manufacturer's published instructions and IEEE C37.102.
- I. Include AC fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase AC systems. Also account for fault-current DC decrement, to address asymmetrical requirements of interrupting equipment.
- J. Include coordination of ground-fault protection devices.
- K. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at equipment indicated on one-line diagram.
  - 1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.
- L. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
  - 2. Adequacy of panelboard bus bars to withstand short-circuit stresses.
  - 3. Application of series-rated devices must be recertified, complying with requirements in NFPA 70.
  - 4. Include in report identification of protective device applied outside its capacity.

### 3.5 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform load-flow and voltage-drop study to determine steady-state loading profile of system. Analyze power system performance two times as follows:
  - 1. Determine load flow and voltage drop based on full-load currents.
  - 2. Determine load flow and voltage drop based on 80 percent of design capacity of load buses.
  - 3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

### 3.6 MOTOR-STARTING STUDY

- A. Perform motor-starting study to analyze transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze effects of motor starting on power system stability.

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- B. Prepare motor-starting study report, noting light flicker for limits proposed by IEEE 1453, and voltage sags so as not to affect operation of other utilization equipment on system supplying motor.

3.7 ARC-FLASH HAZARD STUDY

- A. Comply with NFPA 70E, including Annex D, for arc-flash hazard study.
- B. Preparatory Studies: Obtain short-circuit study and overcurrent protective device coordination study results prior to starting arc-flash hazard study.
- C. Calculate maximum and minimum contributions of fault-current size.
  - 1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.
  - 2. Calculate arc-flash energy at 85 percent of maximum short-circuit current in accordance with IEEE 1584 recommendations.
  - 3. Calculate arc-flash energy at 38 percent of maximum short-circuit current in accordance with NFPA 70E recommendations.
  - 4. Calculate arc-flash energy with utility contribution at minimum and assume no motor contribution.
- D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include low-voltage equipment locations.
- F. Calculate limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must account for changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:
  - 1. Fault contribution from induction motors must not be considered beyond three to five cycles.
  - 2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).
- H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:
  - 1. When circuit breaker is in separate enclosure.
  - 2. When line terminals of circuit breaker are separate from work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.



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3.8 POWER SYSTEM STUDY REPORTS

A. Preparation of Power System Study Reports: Prepare and submit the following:

1. Short-Circuit Study Report Contents:

- a. Executive summary of study findings.
- b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- c. One-line diagram of modeled power system, showing the following:
  - 1) Protective device designations and ampere ratings.
  - 2) Conductor types, sizes, and lengths.
  - 3) Transformer kVA and voltage ratings.
  - 4) Motor and generator designations and kVA ratings.
  - 5) Switchboard and panelboard designations and ratings.
  - 6) Derating factors and environmental conditions.
  - 7) Revisions to electrical equipment required by study.
- d. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.
- e. Short-Circuit Study Input Data:
  - 1) One-line diagram of system being studied.
  - 2) Power sources available.
  - 3) Manufacturer, model, and interrupting rating of protective devices.
  - 4) Conductors.
  - 5) Transformer data.
- f. Protective Device Evaluation:
  - 1) Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
  - 2) Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
  - 3) For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  - 4) For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
  - 5) Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- g. Short-Circuit Study Output Reports:
  - 1) Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

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- a) Voltage.
    - b) Calculated fault-current magnitude and angle.
    - c) Fault-point X/R ratio.
    - d) Equivalent impedance.
  - 2) Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a) Voltage.
    - b) Calculated symmetrical fault-current magnitude and angle.
    - c) Fault-point X/R ratio.
    - d) Calculated asymmetrical fault currents based on fault-point X/R ratio; based on calculated symmetrical value multiplied by 1.6; and based on calculated symmetrical value multiplied by 2.7.
  - 3) Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a) Voltage.
    - b) Calculated symmetrical fault-current magnitude and angle.
    - c) Fault-point X/R ratio.
    - d) No AC Decrement (NACD) ratio.
    - e) Equivalent impedance.
    - f) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
    - g) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.
2. Overcurrent Protection Device Coordination Study Report Contents:
- a. Executive summary of study findings.
  - b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
  - c. One-line diagram of modeled power system, showing the following:
    - 1) Protective device designations and ampere ratings.
    - 2) Conductor types, sizes, and lengths.
    - 3) Transformer kVA and voltage ratings.
    - 4) Motor and generator designations and kVA ratings.
    - 5) Switchboard and panelboard designations.
    - 6) Revisions to electrical equipment required by study.
  - d. Report recommended settings of protective devices, ready to be applied in field. Use manufacturer's data sheets for recording recommended setting of overcurrent protective devices when available.
    - 1) Phase and Ground Relays:
      - a) Device tag.
      - b) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.

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- c) Recommendations on improved relaying systems, if applicable.
    - 2) Circuit Breakers:
      - a) Adjustable pickups and time delays (long time, short time, and ground).
      - b) Adjustable time-current characteristic.
      - c) Adjustable instantaneous pickup.
      - d) Recommendations on improved trip systems, if applicable.
    - 3) Fuses: Show current rating, voltage, and class.
  - e. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for switching schemes and for emergency periods where power source is local generation. Show the following information:
    - 1) Device tag and title, one-line diagram with legend identifying portion of system covered.
    - 2) Terminate device characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
    - 3) Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
    - 4) Plot the following listed characteristic curves, as applicable:
      - a) Power utility's overcurrent protective device.
      - b) Medium-voltage equipment overcurrent relays.
      - c) Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
      - d) Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
      - e) Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
      - f) Cables and conductors damage curves.
      - g) Ground-fault protective devices.
      - h) Motor-starting characteristics and motor damage points.
      - i) Generator short-circuit decrement curve and generator damage point.
    - 5) Maintain selectivity for tripping currents caused by overloads.
    - 6) Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
    - 7) Provide adequate time margins between device characteristics such that selective operation is achieved.
    - 8) Comments and recommendations for system improvements.
3. Arc-Flash Hazard Study Report Contents:
- a. Executive summary of study findings.
  - b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition

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- of terms, and guide for interpretation of results.
- c. One-line diagram, showing the following:
    - 1) Protective device designations and ampere ratings.
    - 2) Conductor types, sizes, and lengths.
    - 3) Transformer kVA and voltage ratings, including derating factors and environmental conditions.
    - 4) Motor and generator designations and kVA ratings.
    - 5) Switchboard panelboard designations, and ratings.
  - d. Short-circuit study output data.
  - e. Overcurrent protective device coordination study report contents.
  - f. Arc-Flash Study Output Reports:
    - 1) Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:
      - a) Voltage.
      - b) Calculated symmetrical fault-current magnitude and angle.
      - c) Fault-point X/R ratio.
      - d) No AC Decrement (NACD) ratio.
      - e) Equivalent impedance.
      - f) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
      - g) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.
  - g. Incident Energy and Flash Protection Boundary Calculations:
    - 1) Arcing fault magnitude.
    - 2) Protective device clearing time.
    - 3) Duration of arc.
    - 4) Arc-flash boundary.
    - 5) Restricted approach boundary.
    - 6) Limited approach boundary.
    - 7) Working distance.
    - 8) Incident energy.
    - 9) Hazard risk category.
    - 10) Recommendations for arc-flash energy reduction.
  - h. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

### 3.9 FIELD ADJUSTMENT FOR DEVICE COORDINATION

- A. Adjust relay and protective device settings in accordance with recommended settings provided by coordination study. Field adjustments must be completed by engineering service division of equipment manufacturer under "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with protective

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device coordination studies.

- C. Testing and adjusting must be by qualified low-voltage electrical testing and inspecting agency.
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for adjustable overcurrent protective devices.

3.10 WARNING LABELING OF ARC-FLASH HAZARDS

- A. Apply arc-flash label on front cover for each equipment included in study, including each piece of equipment listed below:
  - 1. Medium-voltage switches.
  - 2. Switchboards.
  - 3. Panelboards.
  - 4. Low voltage transformers.
  - 5. Safety switches.
  - 6. Control panels.
- B. Base arc-flash label data on highest values calculated at each location.
- C. Machine print warning labels with no handwritten or field-applied markings.
- D. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.
- E. Indicate on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.
  - 1. Indicate arc-flash energy.
  - 2. Indicate protection level required.

END OF SECTION

## SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Electrical equipment including the following:
  - a. Transformers.
  - b. Primary and secondary service electrical systems.
  - c. Distribution and branch-circuit panelboards.
  - d. Lightning protection systems.
  - e. Grounding systems.
  - f. Generator.
2. Controls and instrumentation, including the following:
  - a. Equipment monitoring systems.
  - b. Energy monitoring and control systems.
  - c. Electrical metering and metering system.
  - d. Lighting control systems.
  - e. Security systems.
  - f. Fire-alarm systems.

B. Related Requirements:

1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
2. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

#### 1.2 DEFINITIONS

- A. BoD: Basis-of-Design Document, as defined in Section 019113 "General Commissioning Requirements."
- B. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."
- C. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- D. OPR: Owner's Project Requirements, as defined in Section 019113 "General Commissioning Requirements."

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- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they mean "as-built" systems, assemblies, subsystems, equipment, and components.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Construction Checklists by CxA: Draft construction checklists will be created by CxA for Contractor review.
- C. Construction Checklists by Contractor: Include the following and comply with requirements in Section 019113 "General Commissioning Requirements" for construction checklists:
  - 1. Instrumentation and control for electrical systems.
  - 2. Instrumentation and control for lighting control systems.
  - 3. Low-voltage power cables.
  - 4. Control voltage power cables.
  - 5. Electrical feeders and branch circuits.
  - 6. Liquid-filled transformers.
  - 7. Dry-type transformers.
  - 8. Switchboard assemblies rated 1200 A or greater.
  - 9. Low-voltage motor starters.
  - 10. Low-voltage surge protective devices.
  - 11. Medium-voltage power cables.
  - 12. Metering devices.
  - 13. Molded-case circuit breakers.
  - 14. Low-voltage power circuit breakers.
  - 15. Grounding systems.
  - 16. Ground-fault protection systems.
  - 17. Panelboards.
  - 18. Receptacles and devices.
  - 19. Engine generators.
  - 20. Automatic transfer switches.
  - 21. Battery systems.
  - 22. Battery chargers.
  - 23. Lighting.
  - 24. Vehicle charging equipment.

### 1.4 QUALITY ASSURANCE

- A. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:
  - 1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
    - a. Equipment/instrument identification number.
    - b. Planned Cx application or use.

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- c. Manufacturer, make, model, and serial number.
  - d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
- 2. Test equipment and instrumentation must meet the following criteria:
  - a. Capable of testing and measuring performance within the specified acceptance criteria.
  - b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
  - c. Be maintained in good repair and operating condition throughout duration of use on Project.
  - d. Be recalibrated/repared if dropped or damaged in any way since last calibrated.

B. Proprietary Test Instrumentation and Tools:

- 1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:
  - a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:
    - 1) Instrument or tool identification number.
    - 2) Equipment schedule designation of equipment for which the instrument or tool is required.
    - 3) Manufacturer, make, model, and serial number.
    - 4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.
  - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
  - c. Electrical proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

- A. Prepare detailed construction checklists for electrical systems, subsystems, equipment, and components. Complete and submit construction checklists.



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3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.
- B. Return draft Construction Checklist review comments within 10 days of receipt.
- C. When review comments have been resolved, CxA will provide final construction checklists, marked "Approved for Use, (date)."
- D. Use only construction checklists, marked "Approved for Use, (date)."

3.3 GENERAL TESTING REQUIREMENTS

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.
- B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.
- E. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.
- F. Construction Checklists: Prepare and submit detailed construction checklists for electrical systems, subsystems, equipment, and components.
  - 1. Contributors to development of construction checklists must include, but are not limited to, the following:
    - a. Electrical systems and equipment installers.
    - b. Electrical instrumentation and controls installers.
- G. Perform tests using design conditions, whenever possible.
  - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.

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2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
  3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.
- I. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- J. Coordinate schedule with, and perform Cx activities at the direction of the CxA.
- K. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Sections specifying electrical systems and equipment.
- L. Provide qualified testing and inspecting agency personnel in accordance with Section 260010 "Supplemental Requirements for Electrical," instrumentation, tools, and equipment to complete and document the following:
1. Performance tests.
  2. Demonstration of a sample of performance tests.
  3. Cx tests.
  4. Cx test demonstrations.

### 3.4 Cx TESTS FOR ELECTRICAL SYSTEMS

- A. Verification of Electrical System Operation:
1. Prerequisites: Acceptance of results for construction checklists for Division 26 electrical components associated with electrical system.
  2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
  3. Test Purpose: Verify operation of electrical system.
  4. Test Conditions: Energize components of electrical system, one at a time.
  5. Acceptance Criteria: Proper operation of electrical system over a 24-hour period.
- B. Verification of Control and Instrumentation:
1. Prerequisites: Acceptance of results for construction checklists.
    - a. Section 260923 "Lighting Control Devices."
    - b. Section 260943.23 "Relay-Based Lighting Controls."
    - c. Section 262713 "Electricity Metering."
    - d. Division 28 systems.
- C. Test Purpose: Verify operation of control and monitoring systems for Normal and Essential electrical systems.
- D. Test Conditions:

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1. Energize components of Normal electrical system.
  2. Test operation of equipment.
- E. Acceptance Criteria: Operation of equipment according to OPR.

END OF SECTION

## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Outdoor photoelectric switches.
2. Daylight-harvesting controls.
3. Business occupancy and vacancy sensors.
4. Storage occupancy sensors.
5. Emergency lighting controls.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional coordination, scheduling, sequencing, submittal, and installation requirements applicable to the Work for electrical, communications, and electronic safety and security systems on the Project, including wiring methods.
2. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding of lighting control devices referenced by this Section.
3. Section 260529 "Hangers and Supports for Electrical Systems" specifies hangers and supports referenced by this Section.
4. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs referenced by this Section.
5. Section 262726 "Wiring Devices" for wall-box dimmers and manual light switches.

#### 1.2 DEFINITIONS

- A. BCELTS: Branch circuit emergency lighting transfer switch.
- B. DPDT: Double pole double throw.
- C. DPST: Double pole single throw.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. PIR: Passive infrared.
- G. SPDT: Single pole double throw.
- H. SPST: Single pole single throw.

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1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
    - a. If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
    - b. Listing criteria identified in approval letter must match specified listing criteria. UL label indicating approval of equipment's enclosure is not considered approval of equipment for intended application.
    - c. Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for discontinued or superseded products are unacceptable for submitted product.
  - 2. Include manufacturer's sample extended warranty language.
- C. Shop Drawings: Prepare and submit the following:
  - 1. Show installation details for the following:
    - a. Occupancy sensors.
    - b. Vacancy sensors.
  - 2. Interconnection diagrams showing field-installed wiring.
  - 3. Diagrams for power, signal, and control wiring.
- D. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Manufacturer's published instructions.
- C. Field Reports:
  - 1. Manufacturer's field reports for field quality-control support.
  - 2. Field reports for software and firmware upgrades.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

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- B. Warranty documentation.
- C. Software and firmware service agreement.

1.6 WARRANTY

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that lighting control devices perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period. Warranty must convey to Owner upon acceptance of the Work.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of lighting control software.
    - b. Faulty operation of lighting control devices.
  - 2. Initial Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements:
  - 1. Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Must comply with CCR Title 24.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. UL WJFX - Solid-State, Low-Voltage, Outdoor Photoelectric Switch:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Eaton.
    - b. Intermatic, Inc.
    - c. Leviton Manufacturing Co., Inc.
    - d. NSi Industries LLC.
    - e. TE Connectivity Ltd.
    - f. nLight; Acuity Brands Lighting, Inc.
  - 2. Source Limitations: Obtain products from single manufacturer.

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3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. Plug-in, Locking-Type Photocontrols: UL CCN WJFX, including UL 773.
4. Standard Features:
  - a. Solid state; one set of N.O. dry contacts rated for 24 V(dc) at 1 A and 24 V(ac) at 1 A, to operate connected load, and compatible with lighting control system.
  - b. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
  - c. Time Delay: Thirty-second minimum, to prevent false operation.
  - d. Mounting: 1/2 inch threaded male conduit.
  - e. Failure Mode: Luminaire stays ON.
  - f. Power Pack:
    - 1) Dry contacts rated for 20 A driver or LED load at 120 and 277 V(ac), for tungsten at 120 V(ac), and for at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
      - a) LED status lights to indicate load status.
      - b) Plenum rated.
    - 2) Digital controller capable:
      - a) With integral current monitoring.
      - b) Plenum rated.

## 2.3 DAYLIGHT-HARVESTING CONTROLS

### A. UL WJCT - Daylight-Harvesting Control Switch:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Eaton.
  - b. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Leviton Manufacturing Co., Inc.
  - d. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - e. NSi Industries LLC.
  - f. Sensor Switch, Inc.
  - g. TE Connectivity Ltd.
  - h. WattStopper; Legrand North America, LLC.
  - i. nLight; Acuity Brands Lighting, Inc.
2. Source Limitations: Obtain products from single manufacturer.

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3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. Photoelectric Switches: UL CCN WJCT, including UL 773A.
4. Standard Features:
  - a. System operates indoor lighting.
  - b. Ceiling-Mounted Switching Controls:
    - 1) Solid-state, light-level sensor unit, with power pack, that detects changes in indoor lighting levels that are perceived by the eye.
  - c. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
  - d. Sensor Output:
    - 1) Contacts rated to operate the associated power pack, complying with UL 773A. Sensor must be powered by the power pack.
    - 2) Digital signal compatible with power pack.
  - e. Power Pack:
    - 1) Dry contacts rated for 20 A driver or LED load at 120 and 277 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
      - a) LED status lights to indicate load status.
      - b) Plenum rated.
    - 2) Digital controller capable. Sensor has 24 V(dc) Class 2 power source.
      - a) With integral current monitoring
      - b) Plenum rated.
  - f. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
  - g. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
  - h. Skylight Sensors Light-Level Monitoring Range: 1000 to 10 000 fc, with an adjustment for turn-on and turn-off levels within that range.
  - i. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
  - j. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
  - k. Test Mode: User selectable, overriding programmed time delay to allow settings check.
  - l. Control Load Status: User selectable to confirm that load wiring is correct.
  - m. Indicator: Two digital displays to indicate the beginning of on-off cycles.
5. Sequence of Operation: As daylight increases, the lights are turned off at a predetermined level. As daylight decreases, the lights are turned on at a predetermined level.



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- a. Lighting control set point is based on two lighting conditions:
    - 1) When no daylight is present.
    - 2) When significant daylight is present (target level).
  - b. System programming is done with two handheld, remote-control tools.
- B. UL WJCT - Daylight-Harvesting Digital Control Dimmer:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Deep Roof Lighting.
    - b. Eaton.
    - c. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - d. Leviton Manufacturing Co., Inc.
    - e. Lithonia Lighting; Acuity Brands Lighting, Inc.
    - f. WattStopper; Legrand North America, LLC.
    - g. nLight; Acuity Brands Lighting, Inc.
  - 2. Source Limitations: Obtain products from single manufacturer.
  - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
    - a. Photoelectric Switches: UL CCN WJCT, including UL 773A.
  - 4. Standard Features:
    - a. Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, lights are dimmed.
    - b. System programming is done with two handheld, remote-control tools.
      - 1) Initial setup tool.
      - 2) Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
    - c. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with power pack, to detect changes in indoor lighting levels that are perceived by the eye.
    - d. Sensor Output: 0-10 V(dc) to operate luminaires. Sensor is powered by controller unit.
    - e. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.
    - f. Power Pack: Digital controller capable. Sensor has 24 V(dc) Class 2 power source.
      - 1) With integral current monitoring.
      - 2) Plenum rated.
  - 5. Sequence of Operation: Lighting control set point is based on the following two lighting conditions:

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- a. When no daylight is present (target level).
- b. When significant daylight is present.

## 2.4 BUSINESS OCCUPANCY AND VACANCY SENSORS

### A. Passive-Infrared (PIR) Occupancy or Vacancy Sensor:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ADT Security Services, Inc.
  - b. Ademco; Honeywell.
  - c. Cooper Lighting Solutions; Signify North America Corp.
  - d. Crestron Electronics, Inc.
  - e. Honeywell Security Group.
  - f. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Leviton Manufacturing Co., Inc.
  - h. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - i. Lutron Electronics Co., Inc.
  - j. Napco Security Technologies, Inc.
  - k. Pass & Seymour; Legrand North America, LLC.
  - l. RAB Lighting.
  - m. WattStopper; Legrand North America, LLC.
2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for one of the following UL product categories:
  - a. Photoelectric Controls: UL CCN WJCT, including UL 773A.
  - b. Energy Management Equipment: UL CCN PAZX, including UL 916 or UL 60730-1.
  - c. Intrusion Detection Units: UL CCN ANSR, including UL 639.
4. Standard Features:
  - a. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
  - b. Power pack.
  - c. Hardwired connection to switch.
  - d. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A Sensor is powered from the power pack.
  - e. Power Pack: Dry contacts rated for 20 A driver or LED load at 120 and 277 V(ac),. Sensor has 24 V(dc), 150 mA, Class 2 power source.
  - f. Mounting:
    - 1) Sensor: Suitable for mounting in any position in a standard device box or outlet box.
    - 2) Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.

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- 3) Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  - g. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  - h. Bypass Switch: Override the "on" function in case of sensor failure.
  - i. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
  - j. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch.
  - 1) Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft when mounted on a 96 inch high ceiling.
  - 2) Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 ft when mounted on a 10 ft high ceiling.
  - 3) Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft, 2000 sq. ft, or 3000 sq. ft when mounted 48 inch above finished floor.
5. Operation:
- a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
- B. Ultrasonic Occupancy or Vacancy Sensor:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Cooper Lighting Solutions; Signify North America Corp.
    - b. Eaton.
    - c. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - d. Lutron Electronics Co., Inc.
    - e. WattStopper; Legrand North America, LLC.
  - 2. Source Limitations: Obtain products from single manufacturer.
  - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for one of the following UL product categories:
    - a. Appliance Controls: UL CCN ATNZ, including UL 60730-1.

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- b. Energy Management Equipment: UL CCN PAZX, including UL 916 or UL 60730-1.
  - c. Intrusion Detection Units: UL CCN ANSR, including UL 639.
4. Standard Features:
- a. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
  - b. Power pack.
  - c. Hardwired connection to switch.
  - d. Power Pack: Dry contacts rated for 20 A driver or LED load at 120 and 277 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
  - e. Mounting:
    - 1) Sensor: Suitable for mounting in any position in a standard device box or outlet box.
    - 2) Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
    - 3) Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  - f. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  - g. Bypass Switch: Override the "on" function in case of sensor failure.
  - h. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
  - i. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
    - 1) Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft when mounted on a 96 inch high ceiling.
    - 2) Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft when mounted on a 96 inch high ceiling.
    - 3) Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft when mounted on a 96 inch high ceiling.
    - 4) Detection Coverage (Corridor): Detect occupancy anywhere within 90 ft when mounted on a 10 ft high ceiling in a corridor not wider than 14 ft.
    - 5) Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft, 2000 sq. ft, or 3000 sq. ft when mounted 84 inch above finished floor.
5. Operation:
- a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied,

or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

C. Dual-Technology, Passive-Infrared (PIR) and Ultrasonic, Occupancy or Vacancy Sensor:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Cooper Lighting Solutions; Signify North America Corp.
  - b. HLI Solutions; brand of GE Current, a Daintree Company.
2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for one of the following UL product categories:
  - a. Energy Management Equipment: UL CCN PAZX, including UL 916 or UL 60730-1.
  - b. Appliance Controls: UL CCN ATNZ, including UL 60730-1.
  - c. Intrusion Detection Units: UL CCN ANSR, including UL 639.
4. Standard Features:
  - a. Ceiling and wall-mounted, solid-state indoor occupancy and vacancy sensors.
  - b. Power pack.
  - c. Hardwired connection to switch.
  - d. Sensitivity Adjustment: Separate for each sensing technology.
  - e. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
    - 1) Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft when mounted on a 96 inch high ceiling.
    - 2) Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft, 2000 sq. ft, or 3000 sq. ft when mounted 48 inch above finished floor.
5. Operation:
  - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

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D. Dual-Technology, Passive-Infrared (PIR) and Passive-Acoustic, Occupancy or Vacancy Sensor:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. HLI Solutions; brand of GE Current, a Daintree Company.
  - b. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - c. SensorWorx; brand of BLP Technologies, Inc.
2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for one of the following UL product categories:
  - a. Energy Management Equipment: UL CCN PAZX, including UL 916 or UL 60730-1.
  - b. Appliance Controls: UL CCN ATNZ, including UL 60730-1.
  - c. Intrusion Detection Units: UL CCN ANSR, including UL 639.
4. Standard Features:
  - a. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
  - b. Power pack.
  - c. Hardwired connection to switch.
  - d. Sensitivity Adjustment: Separate for each sensing technology.
  - e. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
    - 1) Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft when mounted on a 96 inch high ceiling.
    - 2) Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft, 2000 sq. ft, or 3000 sq. ft when mounted 48 inch above finished floor.
5. Operation:
  - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

## 2.5 STORAGE OCCUPANCY SENSORS

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - b. nLight; Acuity Brands Lighting, Inc.
  2. Source Limitations: Obtain products from single manufacturer.
  3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
    - a. Photoelectric Controls: UL CCN WJCT, including UL 773A.
  4. Standard Features:
    - a. Solid-State Unit: Designed to operate with the lamp and ballasts or drivers indicated.
    - b. Power: Line voltage.
      - 1) Operating Ambient Conditions: 32 to 149 deg F.
      - 2) Mounting: Threaded pipe.
      - 3) Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
      - 4) Detector Technology: PIR.
    - c. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 ft.
  5. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.
  6. Accessories: Obtain manufacturer's installation and maintenance kit with laser alignment tool for sensor positioning and power port connectors.
- B. Ceiling-Mounted, Solid-State, Extreme-Temperature Occupancy Sensor:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Eaton.
    - b. Sensor Switch, Inc.
    - c. nLight; Acuity Brands Lighting, Inc.
  2. Source Limitations: Obtain products from single manufacturer.
  3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

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- a. Photoelectric Controls: UL CCN WJCT, including UL 773A.
- 4. Standard Features:
  - a. Operating Ambient Conditions: From minus 40 to plus 125 deg F.
  - b. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
  - c. Separate Power Pack: Dry contacts rated for 20 A driver or LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
  - d. Mounting:
    - 1) Sensor: Suitable for mounting in any position in a standard device box or outlet box.
    - 2) Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
    - 3) Time-Delay and Sensitivity Adjustments: Recessed and concealed behind cover.
  - e. Bypass Switch: Override the "on" function in case of sensor failure.
  - f. Automatic Light-Level Sensor: Adjustable from 2 to 10 fc; keep lighting off when selected lighting level is present.
  - g. Detector Technology: PIR. Ceiling mounted; detect occupants in coverage area by their heat and movement.
    - 1) Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch.
    - 2) Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1500 sq. ft when mounted on a 96 inch high ceiling.
    - 3) Detection Coverage (High Bay): Detect occupancy within 25 ft when mounted on a 25 ft high ceiling.
- 5. Operation: Turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.

## 2.6 EMERGENCY LIGHTING CONTROLS

### A. UL FTBR - Automatic Load Control Relay:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Bodine; Signify North America; Signify Holding.
  - b. Chloride; Signify North America; Signify Holding.
  - c. HLI Solutions; brand of GE Current, a Daintree Company.
  - d. Intelligent Lighting Controls Inc.
  - e. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - f. WattStopper; Legrand North America, LLC.



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- g. nLight; Acuity Brands Lighting, Inc.
- 2. Source Limitations: Obtain products from single manufacturer.
- 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. Emergency Lighting and Power Equipment: UL CCN FTBR, including UL 924.
- 4. Standard Features:
  - a. N.C., electrically held relay.
  - b. Coil Rating: 120 277 V.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 SELECTION OF CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

#### 3.3 INSTALLATION OF LIGHTING CONTROL DEVICES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:

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1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Electrical Maintenance: NFPA 70B.
3. Electrical Safety: NFPA 70E.
4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
5. Communications Work: BICSI N1.
6. Life Safety and Means of Egress Work: NFPA 101.
7. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
8. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
2. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.
3. Installation of Industrial Control Switches: Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.
4. Installation of Wiring:
  - a. Conduit: Minimum conduit size is 1/2 inch.
  - b. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's published instructions.
  - c. Size conductors in accordance with lighting control device manufacturer's published instructions unless otherwise indicated.
  - d. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

D. Interfaces with Other Work:

1. Identification: Provide labels for lighting control devices and associated electrical equipment.
  - a. Identify field-installed conductors, interconnecting wiring, and components.
  - b. Label each enclosure with engraved metal or laminated-plastic nameplate.
  - c. Identify controlled circuits in lighting contactors.
  - d. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
  - e. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Administrant for Electrical Power Tests and Inspections:

1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

B. Administrant for Lighting Tests and Inspections:

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1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- C. Field tests must be witnessed by Architect.
- D. Tests and Inspections:
  1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Nonconforming Work:
  1. Lighting control devices will be considered defective if they do not pass tests and inspections.
  2. Remove and replace defective units and retest.
- F. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to the Project site during other-than-normal occupancy hours for this purpose. Some of the Work may be required during hours of darkness.
  1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
  3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

### 3.6 CLOSEOUT ACTIVITIES

- A. Demonstration:
  1. With assistance from factory-authorized service representatives, demonstrate to Owner's maintenance and clerical personnel and building occupants how to operate the following systems and equipment:
    - a. Lighting control devices.
- B. Training:
  1. With assistance from factory-authorized service representatives, train Owner's maintenance personnel on the following topics:
    - a. How to adjust, operate, and maintain lighting control devices.

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3.7 MAINTENANCE

A. Software and Firmware Service Agreement:

1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for two years.
2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.
  - a. Upgrade Notice: Not less than 30 days; to allow Owner to schedule and access the system.
3. Field Reports for Software and Firmware Upgrades: Prepare and submit report after each update, documenting upgrades installed.

END OF SECTION

## SECTION 260943.23 - RELAY-BASED LIGHTING CONTROLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Lighting control relay panels.
2. Networked lighting control panels.
3. Manual switches and cover plates.
4. Field-mounted signal sources.
5. Conductors and cables.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

#### 1.2 DEFINITIONS

- A. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and cover plates, and conductors and cables.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Sound data including results of operational tests of central dimming controls.
4. Operational documentation for software and firmware.

C. Shop Drawings: For each relay panel and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than Type 1.
3. Detail wiring partition configuration, current, and voltage ratings.

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4. Short-circuit current rating of relays.
5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.
8. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
9. Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in.
  - a. Show interconnecting signal and control wiring, and interface devices that show compatibility of inputs and outputs.
  - b. For control interfaces and adapters, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the protocol.

D. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Sample warranties.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panels for installation in accordance with NECA 407.

1.6 WARRANTY

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that components of standalone multipreset modular dimming controls perform in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended warranty period.
  1. Initial Extended Warranty Period: Two year(s) from date of Substantial Completion, for labor, materials, and equipment.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, must open or close one or more lighting control relays in the lighting control panels. Any combination of inputs must be programmable to any number of control relays.
- B. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge suppressors complying with UL 1449, SPD Type 2.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
- D. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- E. Comply with UL 916.

### 2.2 LIGHTING CONTROL RELAY PANELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ABB, Electrification Business.
  - 2. Intermatic, Inc.
  - 3. Leviton Manufacturing Co., Inc.
  - 4. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - 5. Lutron Electronics Co., Inc.
  - 6. Philips; Signify North America; Signify Holding.
  - 7. Siemens Industry, Inc., Energy Management Division.
  - 8. Touch-Plate Technologies.
  - 9. WattStopper; Legrand North America, LLC.
- B. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.
- C. Lighting Control Panel:
  - 1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
  - 2. A vertical barrier separating branch circuits from control wiring.
- D. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
  - 1. Timing Unit:
    - a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.

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- b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
  - c. Four independent schedules, each having 24 time periods.
  - d. Schedule periods settable to the minute.
  - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
  - f. 10 special date periods.
2. Sequencing Control with Override:
  - a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
  - b. Sequencing control must operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
  - c. Override control must allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
  - d. Override control "blink warning" must warn occupants approximately five minutes before actuating the off sequence.
3. Nonvolatile memory must retain all setup configurations. After a power failure, the controller must automatically reboot and return to normal system operation, including accurate time of day and date.

E. Relays:

1. Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating must be not less than 5 kA. Control must be three-wire, 24 V(ac).

F. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, control-voltage inputs, field-installed occupancy sensors, and photo sensors.

G. Operator Interface:

1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
2. Log and display relay on-time.
3. Connect relays to one or more time and sequencing schemes.

## 2.3 NETWORKED LIGHTING CONTROL PANELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB, Electrification Business.
2. Intermatic, Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. Lutron Electronics Co., Inc.
5. Touch-Plate Technologies.
6. WattStopper; Legrand North America, LLC.



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- B. Description: Lighting control panels using mechanically latched relays to control lighting and appliances. The panels must be capable of being interconnected with digital communications to appear to the operator as a single lighting control system.
- C. Lighting Control Panels:
  - 1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
  - 2. A vertical barrier separating branch circuits from control wiring.
- D. Main Control Unit: Installed in the main lighting control panel only; powered from the branch circuit of the standard control unit.
  - 1. Ethernet Communications: Comply with TCP/IP protocol. The main control unit must provide for programming of all control functions of the main and all networked slave lighting control panels including timing, sequencing, and overriding.
  - 2. Web Server: Display information listed below over a standard Web-enabled server for displaying information over a standard browser.
    - a. A secure, password-protected login screen for modifying operational parameters, accessible to authorized users via Web page interface.
    - b. Panel summary showing the master and slave panels connected to the controller.
    - c. Controller diagnostic information.
    - d. Show front panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. These mimic screens must also allow direct breaker control and zone overrides.
  - 3. Timing Unit:
    - a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
    - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
    - c. Four independent schedules, each having 24 time periods.
    - d. Schedule periods settable to the minute.
    - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
    - f. 16 special date periods.
  - 4. Time Synchronization: The timing unit must be updated not less than every hour(s) with the network time server.
  - 5. Sequencing Control with Override:
    - a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
    - b. Sequencing control must operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
    - c. Override control must allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
    - d. Override control "blinking warning" must warn occupants approximately five minutes before actuating the off sequence.
    - e. Activity log, storing previous relay operation, including the time and cause of the change of status.

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- f. Download firmware to the latest version offered by manufacturer.
- E. Standard Control Unit, Installed in All Lighting Control Panels: Contain electronic controls for programming the operation of the relays in the control panel, contain the status of relays, and contain communications link to enable the digital functions of the main control unit. Comply with UL 916.
  - 1. Electronic control for operating and monitoring individual relays, and display relay on-time.
  - 2. Nonvolatile memory must retain all setup configurations. After a power failure, the controller must automatically reboot and return to normal system operation.
  - 3. Integral keypad and digital-display front panel for local setup, including the following:
    - a. Blink notice, time adjustable from software.
    - b. Ability to log and display relay on-time.
    - c. Capability for accepting downloadable firmware so that the latest production features may be added in the future without replacing the module.
- F. Relays:
  - 1. Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating must be not less than 5 kA. Control must be three-wire, 24 V(ac) digital control network.
- G. Power Supply: NFPA 70, Class 2, UL listed, sized for connected equipment, plus not less than 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, control-voltage inputs, field-installed occupancy sensors, and control-voltage photo sensors.
- H. Operator Interface: At the main control unit, provide interface for a tethered connection of for configuring all networked lighting control panels using setup software designed for the specified operating system. Include one portable device for initial programming of the system and training of Owner's personnel. That device must remain the property of Owner.
- I. Software:
  - 1. Menu-driven data entry.
  - 2. Online and offline programming and editing.
  - 3. Provide for entry of the room or space designation for the load side of each relay.
  - 4. Monitor and control all relays, showing actual relay state and the name of the automatic actuating control, if any.
  - 5. Size the software appropriate to the system.

## 2.4 MANUAL SWITCHES AND COVER PLATES

- A. Push-Button Switches: Modular, momentary contact, three wire, for operating one or more relays and to override automatic controls.
  - 1. Match color and style specified in Section 262726 "Wiring Devices."
  - 2. Integral green LED pilot light to indicate when circuit is on.

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- B. Cover Plates: Single and multigang cover plates as specified in Section 262726 "Wiring Devices."
- C. Legend: Engraved or permanently silk-screened on cover plate where indicated. Use designations indicated on Drawings.

## 2.5 FIELD-MOUNTED SIGNAL SOURCES

- A. Daylight Harvesting Switching Controls: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal must be compatible with the relays.
- B. Indoor Occupancy Sensors and Extreme-Temperature Occupancy Sensors: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal must be compatible with the relays.

## 2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- D. Twisted-Pair Data Cable: Category 6.
  - 1. Comply with requirements for twisted pair cabling in Section 260523 "Control-Voltage Electrical Power Cables."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panels in accordance with NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION OF WIRING

A. Wiring Methods:

1. Install conductors and cables concealed in accessible ceilings, walls, and floors where possible.
2. Conceal raceway and cables except in unfinished spaces.
3. Provide plenum-rated cable, where installed exposed or in open cable tray, within environmental airspaces, including plenum ceilings.
4. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 INSTALLATION OF PANELS

- A. Install panels and accessories in accordance with NECA 407.
- B. Mount panel cabinet plumb and rigid without distortion of box.
- C. Install filler plates in unused spaces.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by Architect.
- B. Tests and Inspections:
- C. Nonconforming Work:

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1. Lighting control panel will be considered defective if it does not pass tests and inspections.
  2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
- E. Manufacturer Services:
1. Engage factory-authorized service representative to perform field tests and inspections.

### 3.6 SYSTEM STARTUP

- A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks in accordance with manufacturer's instructions.
  2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system in accordance with approved configuration schedules, time-of-day schedules, and input override assignments.

### 3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.8 MAINTENANCE

- A. Software and Firmware Service Agreement:
1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for two years.
  2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.
    - a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.
  3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.

END OF SECTION

SECTION 261219 – PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pad-mounted, liquid-filled, medium-voltage distribution transformers, with primary and secondary bushings within or without air-terminal enclosures.

1.2 DEFINITIONS

- A. Bushing: An insulating structure including a central conductor, or providing a central passage for a conductor, with provision for mounting on a barrier, conducting or otherwise, for the purpose of insulating the conductor from the barrier and conducting current from one side of the barrier to the other.
- B. Bushing Elbow: An insulated device used to connect insulated conductors to separable insulated connectors on dead-front, pad-mounted transformers and to provide a fully insulated connection. This is also called an "elbow connector."
- C. Bushing Insert: That component of a separable insulated connector that is inserted into a bushing well to complete a dead-front, load break or nonload break, separable insulated connector (bushing).
- D. Bushing Well: A component of a separable insulated connector, either permanently welded or clamped to an enclosure wall or barrier, having a cavity that receives a replaceable component (bushing insert) to complete the separable insulated connector (bushing).
- E. Elbow Connector: See "bushing elbow" above.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Preinstallation Coordination Meeting(s): For transformer. Conduct meeting(s) at Project site.
  1. Attendees: Installers, fabricators, representatives of manufacturers, and administrators for field tests and inspections. Notify Architect, Construction Manager, and BGS's Commissioning Authority of scheduled meeting dates.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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B. Product Data:

1. For each type of product.
  - a. Include rated capacities, operating characteristics, and furnished specialties and accessories.

C. Shop Drawings:

1. For pad-mounted, liquid-filled, medium-voltage transformers.
  - a. Include plans and elevations showing major components and features.
    - 1) Include plan view and cross section of equipment base, showing clearances, required workspace, and locations of penetrations for grounding and conduits.
  - b. Include details of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.
  - c. Include single-line diagram.
  - d. Include list of materials.
  - e. Include nameplate data.
  - f. Manufacturer's published time-current curves of transformer line-side fuses, with transformer damage curve, inrush curve, and thru fault current indicated.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Certificates: For transformers, signed by product manufacturer.
- C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Comply with IEEE C2.

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- C. Comply with IEEE C57.12.00.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Windings Material: Aluminum or copper.
- B. Surge Arresters: Comply with IEEE C62.11, Distribution Class; metal-oxide-varistor type, fully shielded, separable-elbow type, suitable for plugging into inserts provided in line-side section of transformer. Connected in each phase of incoming circuit and ahead of disconnecting device.
- C. Winding Connections: Connection of windings and terminal markings must comply with IEEE C57.12.70.
- D. Efficiency: Comply with 10 CFR 431, Subpart K.
- E. Insulation: Transformer kVA rating must be as follows: Average winding temperature rise above 30 deg C ambient temperature must not exceed 65 deg C and 80 deg C hottest-spot temperature rise at rated kVA when tested in accordance with IEEE C57.12.90, using combination of connections and taps that give highest average winding temperature rise.
- F. Tap Changer: External handle, for de-energized operation.
- G. Tank: Sealed, with welded-on cover. Designed to withstand internal pressure of not less than 7 psi without permanent distortion and 15 psig without rupture. Comply with IEEE C57.12.36.
- H. Enclosure Integrity: Comply with IEEE C57.12.28 for pad-mounted enclosures that contain energized electrical equipment in excess of 600 V that may be exposed to public.
- I. Mounting: Integral skid mounting frame, suitable to allow skidding or rolling of transformer in any direction, and with provision for anchoring frame to pad.
- J. Insulating Liquids:
  - 1. Less-Flammable Liquids:
    - a. Edible-Seed-Oil-Based Dielectric: Listed and labeled by qualified electrical testing laboratory recognized by authorities having jurisdiction as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested in accordance with ASTM D92. Liquid must be biodegradable and nontoxic, having passed Organisation for Economic Co-operation and Development G.L.203 with zero mortality, and must be certified by U.S. Environmental Protection Agency as biodegradable, meeting Environmental Technology Verification requirements.
- K. Sound level must comply with NEMA TR 1 requirements.
- L. Corrosion Protection:
  - 1. Base and Cabinets of Two Compartment Transformers: Fabricate from steel in, not less than No. 13 U.S. gage. Coat transformer with manufacturer's standard green color coating complying with requirements of IEEE C57.12.28, in manufacturer's standard color green.



## 2.3 THREE-PHASE TRANSFORMERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. ERMCO-ECI.
  2. Eaton.
  3. GE Power; General Electric Company.
  4. Hitachi ABB Power Grids Ltd.; ABB & Hitachi Joint Venture.
  5. Howard Industries, Inc.
  6. Prolec GE; A Xignux and General Electric Company Joint Venture.
- B. Description:
1. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  2. Comply with IEEE C57.12.26.
- C. Compartment Construction:
1. Double-Compartment Construction: Individual compartments for line- and load-side sections, formed by steel isolating barriers that extend full height and depth of compartments, with hinged, lift-off doors and three-point latching, with stop in open position and provision for padlocking.
- D. Primary Fusing: Designed and rated to provide thermal protection of transformer by sensing overcurrent and high liquid temperature.
1. 150 kV BIL current-limiting fuses, conforming to requirements of IEEE C37.47.
  2. Interrupting Rating: 50 000 A(rms sym) at system voltage.
  3. Fuse Assembly: Bayonet-type, liquid-immersed, expulsion fuses in series with liquid-immersed, partial-range, current-limiting fuses. Bayonet fuse must sense both high currents and high oil temperature to provide thermal protection to transformer. Connect current-limiting fuses ahead of radial-feed load-break switch.
  4. Provide bayonet fuse assembly with oil retention valve and external drip shield inside housing to eliminate or minimize oil spills. Valve must close when fuse holder is removed and external drip shield is installed.
  5. Provide conspicuously displayed warning adjacent to bayonet fuse(s), cautioning against removing or inserting fuses unless transformer has been de-energized and tank pressure has been released.
- E. Line-Side Section: Dead-front design.
1. To connect primary cable, use separable insulated connectors; coordinated with and complying with requirements of Section 260513 "Medium-Voltage Cables." Bushings must be one-piece units, with ampere and BIL ratings same as connectors.
  2. Bushing inserts:
    - a. Conform to requirements of IEEE 386.
    - b. Rated at 200 A, with voltage class matching connectors. Provide parking stand near bushing wells.

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- c. Provide insulated protective caps for insulating and sealing out moisture from unused bushing inserts.
  - 3. Bushing wells configured for loop-feed application.
  - 4. Access to liquid-immersed fuses.
  - 5. Dead-front surge arresters.
  - 6. Tap-changer operator.
  - 7. Load-Break Switch:
    - a. Loop-feed sectionalizing switches, using three two-position, liquid-immersed-type switches for closed transition loop-feed and sectionalizing operation. Voltage class and BIL must match that of separable connectors, with continuous current rating and load-break rating of 200 A, and make-and-latch rating of 12 kA(rms sym). Switch operation must be as follows:
      - 1) Position I: Line A connected to line B and both lines connected to transformer.
      - 2) Position II: Transformer connected to line A only.
      - 3) Position III: Transformer connected to line B only.
      - 4) Position IV: Transformer disconnected and line A not connected to line B.
      - 5) Position V: Transformer disconnected and line A connected to line B.
  - 8. Ground pad.
- F. Load-Side Section:
- 1. Bushings with spade terminals drilled for terminating number of conductors indicated on Drawings, and lugs that comply with requirements of Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- G. Capacities and Characteristics:
- 1. Power Rating: As indicated on Drawings.
  - 2. Voltage Ratings: V - 480Y/277 V.
  - 3. Taps: Comply with IEEE C57.12.26 requirements.
  - 4. Transformer BIL (kV): Comply with IEEE C57.12.26 requirements.
  - 5. Minimum Tested Impedance (Percent) at 85 deg C: 4.03.
  - 6. Comply with FM Global Class No. 3990.
  - 7. Comply with UL listing requirements for combination classification and listing for transformer and less-flammable insulating liquid.
- H. Transformer Accessories:
- 1. Drain and filter connection.
  - 2. Filling and top filter press connections.
  - 3. Pressure-vacuum gauge.
  - 4. Dial-type analog thermometer with alarm contacts.
  - 5. Automatically resetting pressure-relief device. Device flow must be as recommended by manufacturer.
  - 6. Stainless steel ground connection pads.
  - 7. Machine-engraved nameplate, made of anodized aluminum or stainless steel.

## 2.4 WARNING LABELS AND SIGNS

- A. Comply with requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."
  - 1. High-Voltage Warning Label: Provide self-adhesive warning signs on outside of line-side compartment door(s). Sign legend must be "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. Word "DANGER" must be in white letters on red background and words "HIGH VOLTAGE" must be in black letters on white background.
  - 2. Arc Flash Warning Label: Provide self-adhesive warning signs on outside of line-side compartment door(s), warning of potential electrical arc flash hazards and appropriate personal protective equipment required.

## 2.5 SOURCE QUALITY CONTROL

- A. Testing Administrant: Engage qualified electrical testing agency to evaluate transformer.
- B. Testing: Test and inspect transformer in accordance with IEEE C57.12.90.
- C. Factory Tests and Inspections: Perform the following tests and inspections, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, before delivering to site. Affix label with name and date of manufacturer's certification of system compliance on control units.
  - 1. Resistance.
  - 2. Turns ratio, polarity, and phase relation.
  - 3. Transformer no-load losses and excitation current at 100 percent of ratings.
  - 4. Transformer impedance voltage and load loss.
  - 5. Operation of devices.
  - 6. Lightning impulse.
  - 7. Low frequency.
  - 8. Leak.
  - 9. Perform Optional Tests:
    - a. Transformer no-load losses and excitation current at 110 percent of ratings.
    - b. Insulation power factor.
    - c. Applied potential, except that this test is not required for single-phase transformers or for three-phase Y-Y-connected transformers.
    - d. Induced potential.
    - e. Resistance measurements of windings on rated voltage connection and at tap extreme connections.
    - f. Ratios on rated voltage connection and at tap extreme connections.
    - g. Polarity and phase relation on rated voltage connection.
    - h. No-load loss at rated voltage on rated voltage connection.
    - i. Exciting current at rated voltage on rated voltage connection.
    - j. Impedance.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Examine pad-mounted, liquid-filled, medium-voltage transformers upon delivery.

1. Upon delivery of transformers and prior to unloading, inspect equipment for damage that may have occurred during shipment or storage.
2. Verify that tie rods and chains are undamaged and tight, and that blocking and bracing is tight. Verify that there is no evidence of load shifting in transit, and that readings from transportation shock recorders, if equipped, are within manufacturer's recommendations.
3. Verify that there is no indication of external damage and no dents or scratches in doors and sill, tank walls, radiators and fins, or termination provisions.
4. Verify that there is no evidence of insulating-liquid leakage on transformer surfaces, at weld seams, on line- or load-side bushing parts, and at transformer base.
5. Verify that there is positive pressure or vacuum on tank. Check pressure gauge; it is required to read other than zero.
6. Compare transformers and accessories received with bill of materials to verify that shipment is complete. Verify that transformers and accessories conform with manufacturer's quotation and shop drawings. If shipment is incomplete or does not comply with Project requirements, notify manufacturer in writing immediately.
7. Verify presence of polychlorinated biphenyl content labeling.
8. Unload transformers carefully, observing packing label warnings and handling instructions.
9. Open termination compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

B. Handling:

1. Handle transformers carefully, in accordance with manufacturer recommendations, to avoid damage to enclosure, termination compartments, base, frame, tank, and internal components. Do not subject transformers to impact, jolting, jarring, or rough handling.
2. Protect transformer termination compartments against entrance of dust, rain, and snow.
3. Transport transformers upright, to avoid internal stresses on core and coil mounting assembly and to prevent trapping air in windings. Do not tilt or tip transformers.
4. Verify that transformer weights are within rated capacity of handling equipment.
5. Use only manufacturer-recommended points for lifting, jacking, and pulling. Use lifting lugs when lifting transformers.
6. Use jacks only at corners of tank base plate.
7. Use nylon straps of same length to balance and distribute weight when handling transformers with crane.
8. Use spreaders or lifting beam to obtain vertical lift and to protect transformer from straps bearing against enclosure. Lifting cable pull angles may not be greater than 15 degrees from vertical.
9. Exercise care not to damage tank base structure when handling transformer using skids or rollers. Use skids to distribute stresses over tank base when using rollers under large transformers.

C. Storage:

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1. Store transformers in accordance with manufacturer's recommendations.
  2. Transformers may be stored outdoors. If possible, store transformers at final installation locations on concrete pads. If dry concrete surfaces are unavailable, use pallets of adequate strength to protect transformers from direct contact with ground. Ensure transformer is level.
  3. Ensure that transformer storage location is clean and protected from severe conditions. Protect transformers from dirt, water, contamination, and physical damage. Do not store transformers in presence of corrosive or explosive gases. Protect transformers from weather when stored for more than three months.
  4. Store transformers with compartment doors closed.
  5. Regularly inspect transformers while in storage and maintain documentation of storage conditions, noting discrepancies or adverse conditions. Verify that effective pressure seal is maintained using pressure gauges. Visually check for insulating-liquid leaks and rust spots.
- D. Examine areas and space conditions for compliance with requirements for pad-mounted, liquid-filled, medium-voltage transformers and other conditions affecting performance of the Work.
- E. Examine roughing-in of conduits and grounding systems to verify the following:
1. Wiring entries comply with layout requirements.
  2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will cross section barriers to reach load or line lugs.
- F. Examine concrete bases for suitable conditions for transformer installation.
- G. Pre-Installation Checks:
1. Verify removal of shipping bracing after placement.
  2. Remove sample of insulating liquid in accordance with ASTM D923. Insulating-liquid values must comply with NETA ATS, Table 100.4. Sample must be tested for the following:
    - a. Dielectric Breakdown Voltage: ASTM D877 or ASTM D1816.
    - b. Acid Neutralization Number: ASTM D974.
    - c. Specific Gravity: ASTM D1298.
    - d. Interfacial Tension: ASTM D971.
    - e. Color: ASTM D1500.
    - f. Visual Condition: ASTM D1524.
    - g. Water in Insulating Liquids: Comply with ASTM D1533.
    - h. Power Factor or Dissipation Factor: ASTM D924.
- H. Verify that ground connections are in place and that requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance must be 5  $\Omega$  at transformer location.
- I. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install transformers on concrete equipment base(s).

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- B. Transformer must be installed level and plumb and must tilt less than 1.5 degrees while energized.
- C. Maintain minimum clearances and workspace at equipment in accordance with manufacturer's published instructions and IEEE C2.

### 3.3 CONNECTIONS

- A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
  - 1. For counterpoise, use tinned bare copper cable not smaller than 4/0 AWG, buried not less than 30 inch below grade interconnecting grounding electrodes. Bond surge arrester and neutrals directly to transformer enclosure and then to grounding electrode system with bare copper conductors, sized as shown. Keep lead lengths as short as practicable, with no kinks or sharp bends.
  - 2. Fence and equipment connections may not be smaller than 4 AWG. Ground fence at gate posts and corner posts and at intervals not exceeding 10 ft. Bond gate sections to fence posts using 1/8 by 1 inch tinned flexible braided copper strap and clamps.
  - 3. Make joints in grounding conductors and loops by exothermic weld or compression connector.
  - 4. Terminate grounding and bonding conductors on common equipment grounding terminal on transformer enclosure.
  - 5. Complete transformer tank grounding and lightning arrester connections prior to making other electrical connections.
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
  - 1. Maintain air clearances between energized live parts and between live parts and ground for exposed connections in accordance with manufacturer recommendations.
  - 2. Bundle associated phase, neutral, and equipment grounding conductors together within transformer enclosure. Arrange conductors such that there is not excessive strain that could cause loose connections. Allow adequate slack for expansion and contraction of conductors.
- C. Terminate medium-voltage cables in incoming section of transformers in accordance with Section 260513 "Medium-Voltage Cables."

### 3.4 SIGNS AND LABELS

- A. Comply with installation requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."
- B. Install warning signs as required to comply with 29 CFR 1910.269.

### 3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:

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1. General Field-Testing Requirements:
  - a. Comply with provisions of "Testing and Test Methods" Chapter in NFPA 70B.
  - b. Perform visual and mechanical inspections and electrical tests. Certify compliance with test parameters.
  - c. After installing transformer but before primary is energized, verify that grounding system at transformer is tested at specified value or less.
  - d. After installing transformer and after electrical circuitry has been energized, test for compliance with requirements.
  - e. Visual and Mechanical Inspection:
    - 1) Verify equipment nameplate data complies with Contract Documents.
    - 2) Inspect bolted electrical connections for high resistance using one of the following two methods:
      - a) Use low-resistance ohmmeter to compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
      - b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS, Table 100.12.
2. Medium-Voltage Surge Arrester Field Tests:
  - a. Visual and Mechanical Inspection:
    - 1) Inspect physical and mechanical condition.
    - 2) Verify arresters are clean.
    - 3) Verify that ground leads on devices are individually attached to ground bus or ground electrode.
  - b. Electrical Test:
    - 1) Perform insulation-resistance test on arresters, phase terminal-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Replace units that fail to comply with recommended minimum insulation resistance listed in that table.
    - 2) Perform watts-loss test. Evaluate watts-loss values by comparison with similar units and test equipment manufacturer's published data.
3. Liquid-Filled Transformer Field Tests:
  - a. Visual and Mechanical Inspection:
    - 1) Test dew point of tank gases if applicable.
    - 2) Inspect anchorage, alignment, and grounding.
    - 3) Verify bushings are clean.

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- 4) Verify that liquid level in tanks is within manufacturer's published tolerances.
- 5) Perform specific inspections and mechanical tests recommended by manufacturer.
- 6) Verify presence of transformer surge arresters and that their ratings are as specified.
- 7) Verify that as-left tap connections are as specified.

b. Electrical Tests:

- 1) Perform insulation-resistance tests winding-to-winding and windings-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index; value of index may not be less than 1.0.
- 2) Perform power-factor or dissipation-factor tests on windings in accordance with test equipment manufacturer's published data. Maximum winding insulation power-factor/dissipation-factor values must be in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.3.
- 3) Measure core insulation resistance at 500 V(dc) if core is insulated and core ground strap is removable. Core insulation-resistance values may not be less than 1 M $\Omega$  at 500 V(dc).
- 4) Perform power-factor or dissipation-factor tip-up test on windings greater than 2.5 kV.
- 5) Perform Optional Field Tests:
  - a) Perform turns-ratio tests at tap positions. Turns-ratio test results may not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
  - b) Perform excitation-current test on each phase. Typical excitation-current test data pattern for three-legged core transformer is two similar current readings and one lower current reading. Investigate and correct if test shows different pattern.
  - c) Measure resistance of windings at tap connections, and record temperature-corrected winding-resistance values in Operations and Maintenance Manual.
  - d) Perform applied-voltage test on line- and load-side windings-to-ground. Comply with IEEE C57.12.91, Sections 10.2 and 10.9. This test is not required for single-phase transformers and for three-phase wye-wye-connected transformers.
- 6) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- 7) Remove sample of insulating liquid in accordance with ASTM D923, and perform dissolved-gas analysis in accordance with IEEE C57.104 or ASTM D3612.

B. Nonconforming Work:

1. Equipment and devices will be considered defective if they do not pass tests and inspections.



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2. Remove and replace malfunctioning units and retest.
- C. Prepare test and inspection reports. Record as-left set points of adjustable devices.

3.6 FOLLOW-UP SERVICE

- A. Voltage Monitoring and Adjusting: After Substantial Completion, if requested by BGS, but not more than six months after Final Acceptance, perform the following voltage monitoring:
  1. During period of normal load cycles as evaluated, perform seven days of three-phase voltage recording at outgoing section of transformers. Use voltmeters with calibration traceable to National Institute of Science and Technology standards and with chart speed of not less than 1 inch per hour. Voltage unbalance greater than 1 percent between phases, or deviation of phase voltage from nominal value by more than plus or minus 5 percent during test period, is unacceptable.
  2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:
    - a. Adjust transformer taps.
    - b. Prepare written request for voltage adjustment by electric utility.
  3. Retests: Repeat monitoring, after corrective action is performed, until satisfactory results are obtained.
  4. Report:
    - a. Prepare written report covering monitoring performed and corrective action taken.
- B. Infrared Inspection: Perform survey during periods of maximum possible loading. Remove necessary covers prior to inspection.
  1. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of transformer's electrical power connections.
  2. Instrument: Inspect distribution systems with imaging equipment capable of detecting minimum temperature difference of 1 deg C at 30 deg C.
  3. Record of Infrared Inspection: Prepare certified report that identifies testing technician and equipment used, and lists results as follows:
    - a. Description of equipment to be tested.
    - b. Discrepancies.
    - c. Temperature difference between area of concern and reference area.
    - d. Probable cause of temperature difference.
    - e. Areas inspected. Identify inaccessible and unobservable areas and equipment.
    - f. Identify load conditions at time of inspection.
    - g. Provide photographs and thermograms of deficient area.
  4. Act on inspection results in accordance with recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as possible. Retest until deficiencies are corrected.

END OF SECTION

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution, dry-type transformers with nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Product Data:

1. For each type of product.
  - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  - b. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

C. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

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1.3 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
  - 1. Transformer temporary heating, working clearances, anchoring, torque values, and insulation-resistance testing.
- C. Source quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note shipping damage to packaging and transformer.
  - 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat in accordance with manufacturer's published instructions within enclosure of ventilated-type units, throughout periods during which equipment is not energized and when transformer is not in space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ABB, Electrification Business.
  - 2. Acme Electric; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - 3. Dongan Electric Manufacturing Company.
  - 4. Eaton.
  - 5. Federal Pacific.
  - 6. Hammond Power Solutions Inc.
  - 7. Jefferson Electric, Inc.
  - 8. Lincoln Electric Products Co., Inc.
  - 9. MGM Transformer Company.
  - 10. Mag-Tran; a division of Quality Transformer & Electronics.
  - 11. Marcus Transformer LTD.
  - 12. Micron Industries Corporation.

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13. [Mirus International Inc.](#)
14. [Powersmiths International Corp.; Socomec Group.](#)
15. [Prolec GE; A Xignux and General Electric Company Joint Venture.](#)
16. [Rex Power Magnetics.](#)
17. [Siemens Industry, Inc., Energy Management Division.](#)
18. [SolaHD; Emerson Electric Co., Automation Solutions.](#)
19. [Square D; Schneider Electric USA.](#)
20. [TEMCo Transformers.](#)

- B. Source Limitations: Obtain each type of transformer from single source from single manufacturer.

## 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60 Hz service.
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- C. Transformers Rated 15 kVA and Larger:
1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
  2. Marked as compliant with DOE 2016 efficiency levels by qualified electrical testing laboratory recognized by authorities having jurisdiction.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside transformer enclosure.

## 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
1. One leg per phase.
  2. Core volume must allow efficient transformer operation at 10 percent above nominal tap voltage.
  3. Grounded to enclosure.
- C. Coils: Continuous windings without splices except for taps.
1. Coil Material: Aluminum or copper.
  2. Internal Coil Connections: Brazed or pressure type.
  3. Terminal Connections: Welded or bolted.
- D. Enclosure: Ventilated.

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1. Core and coil must be encapsulated within resin compound using vacuum-pressure impregnation process to seal out moisture and air.
  2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
  3. Wiring Compartment: Sized for conduit entry and wiring installation.
  4. Environmental Protection:
    - a. Indoor: UL 50E, Type 2.
  5. Finish Color: Gray weather-resistant enamel.
- E. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- F. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.
- G. Grounding: Provide ground-bar kit or ground bar installed on inside of transformer enclosure.
- H. Electrostatic Shielding: Windings must have independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
  2. Include special terminal for grounding shield.
- I. Wall Brackets: Manufacturer's standard brackets.
- J. Low-Sound-Level Requirements: Maximum sound levels when factory tested in accordance with IEEE C57.12.91, as follows:
1. 9.01 to 30.00 kVA: 45 dB(A-weighted).
  2. 30.01 to 50.00 kVA: 45 dB(A-weighted) for K-factors of 1, 4, and 9.
  3. 50.01 to 150.00 kVA: 50 dB(A-weighted) for K-factors of 1, 4, and 9.

## 2.4 IDENTIFICATION

- A. Nameplates:
1. Engraved, laminated-acrylic or melamine plastic signs for distribution transformers, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for transformers.

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- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's published instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance must be  $5\ \Omega$  at location of transformer.
- E. Environment: Enclosures must be rated for environment in which they are located.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
- B. Anchor floor-mounted transformers in accordance with manufacturer's published instructions, seismic requirements applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
- C. Secure transformer to concrete base in accordance with manufacturer's published instructions.
- D. Secure covers to enclosure and tighten bolts to manufacturer-recommended torques to reduce noise generation.
- E. Remove shipping bolts, blocking, and wedges.

### 3.3 CONNECTIONS

- A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at conduit and conductor terminations and supports to eliminate sound and vibration transmission to building structure.

### 3.4 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

##### 1. Small (Up to 167 kVA Single-Phase or 500 kVA Three-Phase) Dry-Type Transformer Field Tests:

##### a. Visual and Mechanical Inspection.

- 1) Inspect physical and mechanical condition.
- 2) Inspect anchorage, alignment, and grounding.
- 3) Verify that resilient mounts are free and that shipping brackets have been removed.
- 4) Verify that unit is clean.
- 5) Perform specific inspections and mechanical tests recommended by manufacturer.
- 6) Verify that as-left tap connections are as specified.
- 7) Verify presence of surge arresters and that their ratings are as specified.

##### b. Electrical Tests:

- 1) Measure resistance at windings, taps, and bolted connections.
- 2) Perform insulation-resistance tests winding-to-winding and windings-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: value of index may not be less than 1.0.
- 3) Perform turns-ratio tests at tap positions. Test results may not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
- 4) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

#### B. Test Labeling: On completion of satisfactory testing of units, attach dated and signed "Satisfactory Test" label to tested components.

#### C. Nonconforming Work:

1. Transformer will be considered defective if it does not pass tests and inspections.
2. Remove and replace units that do not pass tests or inspections and retest as specified above.

#### D. Assemble and submit test and inspection reports.

### 3.5 ADJUSTING

- #### A.
- Record transformer secondary voltage at unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

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- B. Output Settings Report: Prepare written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION



## SECTION 262413 - SWITCHBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Switchboards.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.

B. Related Requirements

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

#### 1.2 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data:
1. Switchboards.
  2. Overcurrent protective devices.
  3. Surge protection devices.
  4. Ground-fault protection devices.
  5. Accessories.
  6. Other components.
  7. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

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C. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than UL 50E, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.

D. Field Quality-Control Submittals:

1. Field Quality-Control Reports:
  - a. Test procedures used.
  - b. Test results that comply with requirements.
  - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
  1. Handling, storing, and providing temporary heat.
  2. Mounting accessories and anchoring devices.
  3. Testing and adjusting overcurrent protective devices.
- C. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Warranty documentation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.
- C. Handle and prepare switchboards for installation in accordance with NECA 400.

1.7 WARRANTY

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that switchboard performs in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended-warranty period.
  - 1. Initial Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ABB, Electrification Business.
  - 2. Eaton.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; Schneider Electric USA.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection: Drawings indicate dimensions of electrical space where equipment must be installed.
- D. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.

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- H. Front-Connected, Front-Accessible Switchboards:
  - 1. Main Devices: Fixed, individually mounted.
  - 2. Branch Devices: Panel mounted.
  - 3. Sections front and rear aligned.
- I. Nominal System Voltage: 480Y/277 V.
- J. Main-Bus Continuous: 2000 1600 1200 A.
- K. Indoor Enclosures: Steel, UL 50E, Type 1.
- L. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over rust-inhibiting primer on treated metal surface.
- M. Barriers: Between adjacent switchboard sections.
- N. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.
- O. Service Entrance Rating: Switchboards intended for use as service entrance equipment may contain from one to six service disconnecting means with overcurrent protection, neutral bus with disconnecting link, grounding electrode conductor terminal, and main bonding jumper.
- P. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- Q. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.
- R. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- S. Pull Box on Top and Sides of Switchboard:
  - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
  - 2. Set back from front to clear circuit-breaker removal mechanism.
  - 3. Removable covers may form top, front, and sides. Top covers at rear must be easily removable for drilling and cutting.
  - 4. Bottom must be insulating, fire-resistive material with separate holes for cable drops into switchboard.
  - 5. Cable supports must be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- T. Buses and Connections: Three phase, four wire unless otherwise indicated.
  - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from front of switchboard.
  - 2. Phase- and Neutral-Bus Material:
    - a. Hard-drawn copper of 98 percent conductivity.

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3. Tin-plated aluminum feeder circuit-breaker line connections.
  4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
  5. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors.
  6. Disconnect Links:
    - a. Isolate neutral bus from incoming neutral conductors.
    - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
  7. Neutral Buses: 100 percent of ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
  8. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- U. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- V. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.
- W. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

## 2.2 SURGE PROTECTION DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. ABB, Electrification Business.
  2. Advanced Protection Technologies Inc. (APT).
  3. Eaton.
  4. Siemens Industry, Inc., Energy Management Division.
  5. Square D; Schneider Electric USA.
- B. SPDs: Listed and labeled in accordance with UL 1449, Type 1.
- C. Features and Accessories:
1. Integral disconnect switch.
  2. Internal thermal protection that disconnects SPD before damaging internal suppressor components.
  3. Indicator light display for protection status.
  4. Surge counter.

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- D. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase may not be less than 200 kA. Peak surge current rating must be arithmetic sum of ratings of individual MOVs in each mode.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits may not exceed the following:
  - 1. Line to Neutral: 1200 V for 480Y/277 V.
  - 2. Line to Ground: 1200 V for 480Y/277 V.
  - 3. Line to Line: 2000 V for 480Y/277 V.
- F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits may not exceed the following:
  - 1. Line to Neutral: 700 V.
  - 2. Line to Ground: 700 V.
  - 3. Line to Line: 1000 V.
- G. SCCR: Equal or exceed 100 kA.
- H. Nominal Rating: 20 kA.

## 2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
  - 4. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30 mA trip).
  - 5. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    - f. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.

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- g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
- h. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

## 2.4 INSTRUMENTATION

- A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
  - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
    - a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
    - d. Megawatts: Plus or minus 1 percent.
    - e. Megavars: Plus or minus 1 percent.
    - f. Power Factor: Plus or minus 1 percent.
    - g. Frequency: Plus or minus 0.1 percent.
    - h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
    - i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
    - j. Contact devices to operate remote impulse-totalizing demand meter.
    - k. Communication output to BMS.
  - 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

## 2.5 CONTROL POWER

- A. Control Circuits:
  - 1. 120 V(ac), supplied through secondary disconnecting devices from control-power transformer.
  - 2. 120 V(ac), supplied from remote branch circuit.
- B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to primary side of each control-power transformer at line side of associated main circuit breaker. 120 V secondaries connected through automatic transfer relays to ensure fail-safe automatic transfer scheme.
- C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards in accordance with NECA 400.
  - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's published instructions.
  - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
  - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
  - 4. Install temporary heating during storage in accordance with manufacturer's published instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect performance of equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

#### 3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
  - 1. Switchboards and Accessories: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 400.
  - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
  - 1. Equipment Mounting: Install switchboards on concrete.
    - a. Install conduits entering underneath switchboard, entering under vertical section where conductors will terminate. Install with couplings flush with concrete base. Extend 2 inch above concrete base after switchboard is anchored in place.
    - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, published instructions, and directions furnished with items to be embedded.



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- d. Install anchor bolts to elevations required for proper attachment to switchboards.
  - e. Anchor switchboard to building structure at top of switchboard if required or recommended by manufacturer.
- 2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- 3. Operating Instructions: Frame and mount printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- 4. Install filler plates in unused spaces of panel-mounted sections.
- 5. Install overcurrent protective devices, surge protection devices, and instrumentation.
  - a. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.4 CONNECTIONS

- A. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
- B. Bond conduits entering underneath switchboard to equipment ground bus with bonding conductor sized in accordance with NFPA 70.
- C. Support and secure conductors within switchboard in accordance with NFPA 70.
- D. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

### 3.5 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Mimic Bus:
  - 1. Entire single-line switchboard bus work, as depicted on factory record drawing, on minimum 0.032 inch thick anodized aluminum photoengraved nameplate, located at eye level on front cover of switchboard incoming service section.

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2. Entire single-line switchboard bus work, as depicted on factory record drawing, on engraved minimum 0.0625 inch thick laminated-plastic (Gravoply) nameplate, located at eye level on front cover of switchboard incoming service section.
  3. Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.
  4. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce concise visual presentation of principal switchboard components and connections.
  5. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
- E. Service Equipment Label: Labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Preparation:
- B. Tests and Inspections:
1. Acceptance Testing:
    - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
    - b. Test continuity of each circuit.
  2. Test ground-fault protection of equipment for service equipment in accordance with NFPA 70.
  3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  5. Perform the following infrared scan tests and inspections, and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

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C. Nonconforming Work:

1. Switchboard will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports, including certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

E. Manufacturer Services:

1. Engage factory-authorized service representative to perform field tests and inspections.

3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature in accordance with manufacturer's published instructions, until switchboard is ready to be energized and placed into service.

END OF SECTION

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Panelboards.
2. Disconnecting and overcurrent protective devices.

B. Related Requirements:

1. Section 018116 "Facility Environmental Requirements" specifies temperature, humidity, acoustical, and other field conditions applicable to the Work specified in this Section.
2. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other requirements applicable to the Work for electrical, communications, and electronic safety and security systems on Project, including wiring methods.
3. Section 260529 "Hangers and Supports for Electrical Systems" specifies concrete bases and supports for panelboards installed by this Section.
4. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.
5. Section 260573 "Power System Studies" specifies short-circuit current studies, overcurrent protective device coordination studies, and arc-flash hazard analysis studies.
6. Section 264313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits" specifies Type 1 and Type 2 surge protective devices installed by this Section.

#### 1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. VPR: Voltage protection rating.

#### 1.3 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product. In addition to information identified in Section 013300 "Submittal Procedures," submit the following:

1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
2. Include manufacturer's sample extended warranty language.

C. Shop Drawings: For each panelboard and related equipment:

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1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Key interlock scheme drawing and sequence of operations.

D. Field quality-control reports.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- C. Manufacturer's published instructions.
- D. Field Reports:
  1. Manufacturer's field reports for field quality-control support.
  2. Field reports for voltage monitoring and adjusting.
  3. Field reports for infrared scanning.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Warranty documentation.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation in accordance with NEMA PB 1.

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1.7 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed panelboards perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.
  - 1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Product Selection: Drawings indicate maximum dimensions of electrical space where equipment is must be installed.
- C. Comply with NEMA PB 1.
- D. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: UL 50E, Type 1.
    - b. Outdoor Locations: UL 50E, Type 3R.
    - c. Other Wet or Damp Indoor Locations: UL 50E, Type 4.
  - 2. Height: 7 ft maximum.
  - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
  - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
  - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  - 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  - 7. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Same finish as panels and trim.
    - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- E. Phase, Neutral, and Ground Buses:

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1. Material: Tin-plated aluminum.
    - a. Plating must run entire length of bus.
    - b. Bus must be fully rated for entire length.
  2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
  3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Tin-plated aluminum.
  2. Terminations must allow use of 75 deg C rated conductors without derating.
  3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  4. Main and Neutral Lugs: Mechanical type, with lug on neutral bar for each pole in panelboard.
  5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with lug on bar for each pole in panelboard.
- G. Quality-Control Label: Panelboards or load centers must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- H. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
1. Percentage of Future Space Capacity: 20 percent.
- I. Panelboard Short-Circuit Current Rating:
1. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.
    - a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
    - b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

## 2.2 PANELBOARDS

- A. UL QEUY - Distribution Panelboard:

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ABB, Electrification Business.
  - b. ESL Power Systems, Inc.
  - c. Eaton.
  - d. Mersen USA.
  - e. Siemens Industry, Inc., Energy Management Division.
  - f. Square D; Schneider Electric USA.
2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  - a. Distribution Type Panelboards: UL CCN QEUY; including UL 67 and NEMA PB 1.
4. Standard Features:
  - a. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
    - 1) For doors more than 36 inch high, provide two latches, keyed alike.
  - b. Mains: As indicated.
    - 1) Location: Convertible between top and bottom.
    - 2) Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.
  - c. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
  - d. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.
  - e. Branch Overcurrent Protective Devices: Fused switches.
5. Other Available Features Required by Project:
  - a. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
  - b. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors must be sized for double-sized or parallel conductors as indicated on Drawings.
  - c. Do not mount neutral bus in gutter.
  - d. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - e. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  - f. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.



- g. Split Bus: Vertical buses divided into individual vertical sections.

## 2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ABB, Electrification Business.
  - 2. Eaton.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; Schneider Electric USA.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  - 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
  - 5. GFPE Circuit Breakers: Class B ground-fault protection (30 mA trip).
  - 6. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.
  - 7. Subfeed Circuit Breakers: Vertically mounted.
  - 8. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. UL listed for reverse connection without restrictive line or load ratings.
    - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - e. Ground-Fault Protection: Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - f. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards in accordance with NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
  - 1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA PB 1.1.
  - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
  - 1. Equipment Mounting:
    - a. Install floor-mounted panelboards on concrete.
    - b. Attach panelboard to vertical finished or structural surface behind panelboard.
    - c. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
    - d. Provide seismic control devices.
  - 2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
  - 3. Provide mounting and anchoring devices.
  - 4. Mount top of trim 7.5 ft above finished floor unless otherwise indicated.
  - 5. Mount panelboard cabinet plumb and rigid without distortion of box.
  - 6. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
  - 7. Install overcurrent protective devices and controllers not already factory installed.
    - a. Set field-adjustable, circuit-breaker trip ranges.

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- b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
  - 8. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
  - 9. Install filler plates in unused spaces.
  - 10. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- D. Interfaces with Other Work:
- 1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components.
- B. Install warning signs.
- C. Panelboard Nameplates: Label each panelboard with nameplate.
- D. Device Nameplates: Label each branch circuit device in power panelboards with nameplate.
- E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.
- F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.
- G. Circuit Directory:
  - 1. Provide directory card inside panelboard door, mounted in transparent card holder.
    - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
  - 2. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
    - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
  - 3. Create directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

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3.4 FIELD QUALITY CONTROL

- A. Administrant for Low-Voltage Electrical Tests and Inspections:
  - 1. Administer and perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Nonconforming Work:
  - 1. Panelboards will be considered defective if they do not pass tests and inspections.
  - 2. Remove and replace defective units and retest.
- E. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.
  - 1. Include certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
  - 1. Measure loads during period of normal facility operations.
  - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.

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4. Tolerance: Maximum difference between phase loads, within panelboard, may not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

END OF SECTION

## SECTION 262713 - ELECTRICITY METERING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Electricity meters.
2. Work to accommodate utility company revenue meters, and Designer's electricity meters used to manage electrical power system.

#### 1.2 DEFINITIONS

- A. KY or KYZ Pulse: Term used by metering industry to describe method of measuring consumption of electricity (kWh) that is based on relay opening and closing in response to rotation of disk in meter. Electronic meters generate pulses electronically.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. For each type of meter.
2. For metering infrastructure components.
3. For metering software.

C. Shop Drawings: For electricity-metering equipment.

1. Include elevation views of front panels of control and indicating devices and control stations.
2. Include diagrams for power, signal, and control wiring.
3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include series-combination rating data for modular meter centers with main disconnect device.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Manufacturers' Published Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:

- 1. Installation of metering equipment.

- C. Sample warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

- B. Maintenance Contracts:

- 1. Software and firmware service agreement.

- C. Warranty documentation.

#### 1.6 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed metering equipment performs in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.

- 1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

- B. Special Manufacturer Extended Warranty: Manufacturer warrants that metering equipment performs in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

- 1. Initial Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

- B. Comply with UL 916.

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2.2 ELECTRICITY METERS

- A. System Description: Able to meter designated activity loads, with or without external alarm, control, and communication capabilities, or other optional features.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. ABB, Electrification Business.
  2. Davidge Controls.
  3. E-Mon.
  4. Eaton.
  5. GE Power; General Electric Company.
  6. Leviton Manufacturing Co., Inc.
  7. National Meter Industries.
  8. Sensus Metering Systems.
  9. Siemens Industry, Inc., Energy Management Division.
  10. Square D; Schneider Electric USA.
- C. General Requirements for Meters:
1. Comply with NEMA ANSI C12.1 and NEMA ANSI C12.20, 0.5 accuracy class.
  2. Ambient Temperature: Minus 22 deg F to plus 158 deg F.
  3. Humidity: Zero to 95 percent, noncondensing.
  4. Capacities and Characteristics:
    - a. Circuit: 480/277V and 120/208V.
    - b. Measure: kWh, onboard LED display.
    - c. Remote-Reading Options: None.
  5. Certify that meters comply with NEMA ANSI C12.20 requirements by laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST). Laboratory must use test equipment that is certified annually and is traceable to NIST standards.
  6. Enclosure: Supplied by meter manufacturer, UL 50E, Type 1 minimum, with provisions for locking or sealing.
  7. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
  8. Onboard Nonvolatile Data Storage: kWh, until reset.
  9. Sensors: Current-sensing type, supplied by electronic meter manufacturer, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
    - a. Type: solid core, complying with recommendation of meter manufacturer.
- D. kWhd Meter: Electronic single-phase meters, measuring electricity use and demand. Demand must be integrated over 15-minute interval.
1. Voltage and Phase Configuration: Meter must be designed for use on circuits with voltage rating and phase configuration indicated for its application.
  2. Display: LCD with characters not less than 0.25 inch high, indicating the following:



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- a. Accumulative kWh.
    - b. Current time and date.
    - c. Current demand.
    - d. Historic peak demand.
    - e. Time and date of historic peak demand.
  3. Retain accumulated kWh and historic peak demand in nonvolatile memory, for 36 months.
- E. KY and KYZ Pulse Totalizer:
1. Pulse Totalizer: Instrument for demand and billing applications where one or more utility revenue meters stream KY or KYZ energy pulses. Instrument must totalize kWh accumulated over user-selected period and must log maximum and minimum kWhd for that period. Record each period with date/time stamp. Time period must be user selected from one to 60 minutes.
    - a. Pulse Input: One, individually programmable, KYZ Form C (three-wire) contact pulse channels. Pulse interval, pulse rate, and minimum pulse width must be field adjustable, set for pulse stream provided by utility revenue meter.
    - b. Data Totalizing Capacity of Each Channel: Not less than 149 days at 15-minute intervals.
    - c. Instrument Power: User selectable, 120 V(ac).
    - d. Clock: Line frequency.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
  1. Install arc-flash labels as required by NFPA 70.
- C. Special Techniques:
  1. Wiring Methods:
    - a. Comply with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems."
    - b. Minimum conduit size is metric designator 16 (trade size 1/2).

#### 3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

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1. Series Combination Warning Label: Self-adhesive labels, with text as required by NFPA 70.
2. Equipment Identification Labels: Self-adhesive labels with clear protective overlay. For residential meters, provide additional card holder suitable for printed, weather-resistant card with occupant's name.

### 3.3 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

1. Equipment and Software Setup:
  - a. Set meter date and time clock.
  - b. Test, calibrate, and connect pulse metering system.
  - c. Set and verify billing demand interval for demand meters.
  - d. Report settings and calibration results.
  - e. Set up reporting and billing software, insert billing location names and initial constant values and variable needed for billing computations.
2. Connect load of known power rating, 1.5 kW minimum, to circuit supplied by metered feeder.
3. Turn off circuits supplied by metered feeder and secure them in off condition.
4. Run test load continuously for eight hours minimum, or longer, to obtain measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
5. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
6. Generate test report and billing for each tenant or activity from meter reading tests.

#### B. Nonconforming Work:

1. Electricity metering will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

#### C. Collect, assemble, and submit test and inspection reports.

### 3.4 PROTECTION

- #### A.
- After installation, protect metering equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Designer.

END OF SECTION

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches.
2. General-grade single straight-blade receptacles.
3. Receptacles with ground-fault protective devices.
4. Locking receptacles.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 ALTERNATES

- A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 010000 "Administrative Provisions" and the individual sections specifying the work.

B. Product Data:

1. General-use switches.
2. General-grade single straight-blade receptacles.
3. Receptacles with ground-fault protective devices.
4. Connectors, cords, and plugs.

- C. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 010000 "Administrative Provisions" and the individual sections specifying the work.

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- B. Manufacturers' Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:

1. Single straight-blade receptacles.
2. Receptacles with GFCI device.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES

- A. Toggle Switch:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Leviton Manufacturing Co., Inc.
  - d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
  - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
  - a. Reference Standards: UL CCN WMUZ and UL 20.
4. Options:
  - a. Device Color: As selected by Architect.
  - b. Configuration:
    - 1) General-duty, 120-277 V, 20 A, single pole.
5. Accessories:
  - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
  - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

- A. Duplex Straight-Blade Receptacle:

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Leviton Manufacturing Co., Inc.
  - d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
  - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
  - a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
  - a. Device Color: As selected by Architect.
  - b. Configuration:
    - 1) General-duty, NEMA 5-20R.
5. Accessories:
  - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
  - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

- A. Comply with manufacturer's instructions.
- B. Reference Standards:
  1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
  2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
  3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
  4. Consult Designer for resolution of conflicting requirements.
- C. Identification:

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1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
  - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black-filled lettering, and provide durable wire markers or tags inside device box or outlet box.

D. Interfaces with Other Work:

1. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.

3.2 FIELD QUALITY CONTROL OF SWITCHES

A. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

B. Assemble and submit test and inspection reports.

3.3 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.

B. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

3.4 FIELD QUALITY CONTROL OF CONNECTORS, CORDS, AND PLUGS

A. Tests and Inspections:

1. Perform tests and inspections indicated in manufacturer's instructions.

B. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

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- C. Assemble and submit test and inspection reports.

### 3.5 PROTECTION

- A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Designer.

END OF SECTION

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SECTION 262813 – FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Cartridge fuses rated 600 V ac and less for use in the following:
  - a. Control circuits.
  - b. Enclosed controllers.
  - c. Enclosed switches.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
    - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
  - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 3. Current-limitation curves for fuses with current-limiting characteristics.
  - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
  - 5. Coordination charts and tables and related data.
  - 6. Fuse sizes for elevator feeders and elevator disconnect switches.



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1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," include the following:
  - 1. Ambient temperature adjustment information.
  - 2. Current-limitation curves for fuses with current-limiting characteristics.
  - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
  - 4. Coordination charts and tables and related data.

1.5 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Bussmann, an Eaton business.
  - 2. Edison; a brand of Bussmann by Eaton.
  - 3. Littelfuse, Inc.
  - 4. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
  - 1. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  - 2. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, time delay.
  - 3. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  - 4. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.

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- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  - 1. Feeders: Class L, time delay, Class RK5, time delay, or Class J, time delay.
  - 2. Motor Branch Circuits: Class RK5, time delay.
  - 3. Large Motor Branch (601-4000 A): Class L, time delay.
  - 4. Other Branch Circuits: Class RK5, time delay.
  - 5. Control Transformer Circuits: Class CC, time delay, control transformer duty.
  - 6. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

#### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

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3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

## SECTION 262816 - ENCLOSED SWITCHES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Enclosures.

#### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

#### 1.4 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Product Data: For each type of enclosed switch, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.
- C. Shop Drawings: For enclosed switches.
  - 1. Include equipment device sizes, dimensions, details, and attachments to other work.

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2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
    - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  2. Fuse Pullers: Two for each size and type.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  2. Altitude: Not exceeding 6600 feet.

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1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. ABB Inc.
2. Eaton.
3. General Electric Company.
4. SIEMENS Industry, Inc.; Energy Management Division.
5. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty:
1. Single throw.
2. Two pole and three pole.
3. 240-V ac and 600V.
4. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
5. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. Lockable in open and closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
3. Hookstick Handle: Allows use of a hookstick to operate the handle.

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4. No hookstick needs to be provided.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Provide shunt trip disconnect switch for elevators.

## 2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. ABB Inc.
  2. Eaton.
  3. General Electric Company.
  4. SIEMENS Industry, Inc.; Energy Management Division.
  5. Square D; by Schneider Electric.
- B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 30 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position. Lockable in open and closed position.
- C. Type HD, Heavy Duty, Three Pole, Single Throw, 240-V ac and 600V, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. Lockable in open and closed position.
- D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
  2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  3. Lugs: Mechanical type, suitable for number, size, and conductor material.

## 2.4 ENCLOSURES

- A. Enclosed Switches: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure must be finished with gray baked enamel paint.
- C. Operating Mechanism: The cover interlock mechanism must have an externally operated override. The override must not permanently disable the interlock mechanism, which must return to the locked position once the override is released. The tool used to override the cover interlock mechanism must not be required to enter the enclosure in order to override the interlock.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance of the Work.

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- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work must indicate Installer's acceptance of the areas and conditions as satisfactory.

### 3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.
  - 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

### 3.3 INSTALLATION

- A. Coordinate layout and installation of switches, and components with equipment served and adjacent surfaces. Maintain minimum NFPA 70 required workspace clearances and required clearances for equipment access doors and access panels.
- B. Install individual wall-mounted switches with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

### 3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.



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- d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
  - e. Verify that fuse sizes and types match the equipment served, Specifications and Drawings.
  - f. Verify that each fuse has adequate mechanical support and contact integrity.
  - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
    - 1) Use a low-resistance ohmmeter.
      - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
      - a) Bolt-torque levels must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and as indicated.
  - i. Verify correct phase barrier installation.
  - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Measure contact resistance across each switchblade fuseholder. Drop values must not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
  - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- C. Enclosed switches will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

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1. Test procedures used.
2. Include identification of each enclosed switch tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

## SECTION 263213.13 - DIESEL-ENGINE-DRIVEN GENERATOR SETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Diesel-engine-driven generator sets.
2. Diesel engine.
3. Diesel fuel-oil system.
4. Control and monitoring.
5. Generator overcurrent and fault protection.
6. Generator, exciter, and voltage regulator.
7. Load bank.
8. Outdoor engine generator enclosure.
9. Remote radiator motors.
10. Vibration isolation devices.

B. Related Requirements:

1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

#### 1.2 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.

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6. Include airflow requirements for cooling and combustion air in cubic feet per minute at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F. Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

C. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
5. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.

A. Delegated Design Submittal: In addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineers responsible for their preparation.

1. Drawings showing location of each device, and installation details as need to comply with listing conditions of device.

1.4 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

B. Qualification Data: For Installer manufacturer and testing agency.

C. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

D. Field quality-control reports.

E. Warranty: For special warranty.

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1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
    - b. Operating instructions laminated and mounted adjacent to generator location.
    - c. Training plan.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DIESEL-ENGINE-DRIVEN GENERATOR SETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Caterpillar, Inc.; Electric Power Division.
  - 2. Cummins Power Generation.
  - 3. Generac.
  - 4. Hipower Systems.
  - 5. Kohler Power Systems.
  - 6. Rolls-Royce Solutions America Inc.

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- B. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. B11 Compliance: Comply with B11.19.
- B. NFPA Compliance:
  - 1. Comply with NFPA 37.
  - 2. Comply with NFPA 70.
  - 3. Comply with NFPA 110 requirements for Level 1 EPSS.
- C. UL Compliance: Comply with UL 2200.
- D. Engine Exhaust Emissions: Comply with EPA Tier 2 requirements and applicable state and local government requirements.
- E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Ambient Temperature: 41 to 104 deg F.
  - 2. Relative Humidity: Zero to 95 percent.
  - 3. Altitude: Sea level to 1000 feet.
- G. Unusual Service Conditions: Engine generator equipment and installation are required to operate under the following conditions:

## 2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Power Rating: Standby.
- D. Service Load: As indicated on drawings.
- E. Power Factor: 0.8, lagging.
- F. Frequency: 60 Hz.
- G. Voltage: 480-V ac.

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- H. Phase: Three-phase, four wire, wye.
- I. Induction Method: Naturally aspirated.
- J. Governor: Adjustable isochronous, with speed sensing.
- K. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
- L. Capacities and Characteristics:
  - 1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
  - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- M. Engine Generator Performance for Sensitive Loads:
  - 1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
    - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
  - 2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
  - 3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
  - 4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
  - 5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
  - 6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
  - 7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
  - 8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
  - 9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
    - a. Provide permanent magnet excitation for power source to voltage regulator.
  - 10. Start Time:

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- a. Comply with NFPA 110, Type 10 system requirements.
- b. 10 seconds.

2.4 DIESEL ENGINE

- A. Fuel: ASTM D975, diesel fuel oil, Grade 2-D S15.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: Engine or skid-mounted.
  - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  - 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
  - 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499 and with NFPA 110 requirements for Level 1 equipment for heater capacity.
- E. Integral Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator set mounting frame and integral engine-driven coolant pump.
  - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
  - 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
  - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  - 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
    - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
    - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- F. Remote Cooling System: Closed loop, liquid cooled, with remote radiator and integral engine driven coolant pump. Comply with requirements in Section 232113 "Hydronic Piping" for coolant piping.
  - 1. Configuration: Vertical air discharge.
  - 2. Radiator Core Tubes: Nonferrous-metal construction other than aluminum.
  - 3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.



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4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
  5. Fan: Driven by totally enclosed electric motor with sealed bearings.
  6. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  7. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- G. Muffler/Silencer:
1. Commercial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
    - a. Minimum sound attenuation of 12 dB at 500 Hz.
    - b. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 90 dBA or less.
- H. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- I. Starting System: 24-V electric, with negative ground.
1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
  2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
  3. Cranking Cycle: As required by NFPA 110 for system level specified.
  4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
  5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
  6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
  7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
  8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
  9. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
    - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

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- b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
- c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 DIESEL FUEL-OIL SYSTEM

- A. Comply with NFPA 37.
- B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 231113 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.
- C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- D. Fuel Filtering: Remove water and contaminants larger than 1 micron.
- E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
  - 1. Tank level indicator.
  - 2. Fuel-Tank Capacity: 24 hour run time at full 100 percent capacity.
  - 3. Leak detection in interstitial space.
  - 4. Vandal-resistant fill cap.
  - 5. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.6 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

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- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- C. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.
- D. Comply with UL 508A.
- E. Configuration:
  - 1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.
  - 2. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel. Panel shall be powered from the engine generator battery.
  - 3. Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel shall be powered from the engine generator battery. Panel features shall include the following:
    - a. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6.
- F. Control and Monitoring Panel:
  - 1. Digital engine generator controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
  - 2. Analog control panel with dedicated gages and indicator lights for the instruments and alarms indicated below.
  - 3. Instruments: Located on the control and monitoring panel and viewable during operation.
    - a. Engine lubricating-oil pressure gage.
    - b. Engine-coolant temperature gage.
    - c. DC voltmeter (alternator battery charging).
    - d. Running-time meter.
    - e. AC voltmeter, connected to a phase selector switch.
    - f. AC ammeter, connected to a phase selector switch.
    - g. AC frequency meter.
    - h. Generator-voltage adjusting rheostat.
  - 4. Controls and Protective Devices: Controls, shutdown devices, and common alarm indication, including the following:
    - a. Cranking control equipment.
    - b. Run-Off-Auto switch.

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- c. Control switch not in automatic position alarm.
- d. Overcrank alarm.
- e. Overcrank shutdown device.
- f. Low-water temperature alarm.
- g. High engine temperature prealarm.
- h. High engine temperature.
- i. High engine temperature shutdown device.
- j. Overspeed alarm.
- k. Overspeed shutdown device.
- l. Low fuel main tank.
- m. Coolant low-level alarm.
- n. Coolant low-level shutdown device.
- o. Coolant high-temperature prealarm.
- p. Coolant high-temperature alarm.
- q. Coolant low-temperature alarm.
- r. Coolant high-temperature shutdown device.
- s. EPS load indicator.
- t. Battery high-voltage alarm.
- u. Low cranking voltage alarm.
- v. Battery-charger malfunction alarm.
- w. Battery low-voltage alarm.
- x. Lamp test.
- y. Contacts for local and remote common alarm.
- z. Low-starting air pressure alarm.
- aa. Low-starting hydraulic pressure alarm.
- bb. Remote manual stop shutdown device.
- cc. Air shutdown damper alarm when used.
- dd. Air shutdown damper shutdown device when used.
- ee. Generator overcurrent-protective-device not-closed alarm.
- ff. Hours of operation.
- gg. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.

G. Engine Generator Metering: Comply with Section 262713 "Electricity Metering."

H. Connection to Datalink:

- 1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
- 2. Provide connections for datalink transmission of indications to remote data terminals via Ethernet. Data system connections to terminals are covered in Section 260913 "Electrical Power Monitoring and Control."

I. Common Remote Panel with Common Audible Alarm: Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine generator battery.

J. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until

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silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

1. Overcrank alarm.
2. Low water-temperature alarm.
3. High engine temperature prealarm.
4. High engine temperature alarm.
5. Low lube oil pressure alarm.
6. Overspeed alarm.
7. Low fuel main tank alarm.
8. Low coolant level alarm.
9. Low cranking voltage alarm.
10. Contacts for local and remote common alarm.
11. Audible-alarm silencing switch.
12. Air shutdown damper when used.
13. Run-Off-Auto switch.
14. Control switch not in automatic position alarm.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Lamp test.
18. Low-cranking voltage alarm.
19. Generator overcurrent-protective-device not-closed alarm.

- K. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.
- L. Remote Emergency-Stop Switch: Flush; wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

## 2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.
1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
  2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.
- B. Generator Overcurrent Protective Device:
1. Molded-case circuit breaker, thermal-magnetic type; 100 percent rated; complying with UL 489:
    - a. Tripping Characteristic: Designed specifically for generator protection.
    - b. Trip Rating: Matched to generator output rating.
    - c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
    - d. Mounting: Adjacent to, or integrated with, control and monitoring panel.

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2. Molded-case type disconnect switch; 100 percent rated:
    - a. Trip Rating: Matched to generator output rating.
    - b. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.
  - C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other engine generator protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:
    1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other engine generator malfunction alarms. Contacts shall be available for load shed functions.
    2. Under single- or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
    3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
    4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
  - D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
    1. Indicate ground fault with other engine generator alarm indications.
    2. Trip generator protective device on ground fault.
- 2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR
- A. Comply with NEMA MG 1.
  - B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
  - C. Electrical Insulation: Class H or Class F.
  - D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide 12-lead alternator.
  - E. Range: Provide limited broad extended range of output voltage by adjusting the excitation level.
  - F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
  - G. Enclosure: Dripproof.
  - H. Instrument Transformers: Mounted within generator enclosure.

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- I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
  - 1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
  - 2. Maintain voltage within 30 percent on one step, full load.
  - 3. Provide anti-hunt provision to stabilize voltage.
  - 4. Maintain frequency within 10 percent and stabilize at rated frequency within 5 seconds.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum.

2.9 LOAD BANK

- A. Description:
  - 1. Permanent, radiator-mounted, resistive unit capable of providing a balanced three-phase, delta-connected load to engine generator at 50 percent rated-system capacity. Unit shall be capable of selective control of load in 25 percent steps of load-bank rating and with minimum step changes of approximately 5 and 10 percent available.
- B. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and stainless-steel supports. Elements shall be double insulated and designed for repetitive on-off cycling. Elements shall be mounted in removable aluminized-steel heater cases. Galvanized steel is prohibited. Element's maximum resistance shall be between 100 and 105 percent of rated resistance.
- C. Load-Bank Heat Dissipation: Integral fan with totally enclosed motor shall provide uniform cooling airflow through load elements. Airflow and coil operating current shall be such that, at maximum load, with ambient temperature at the upper end of specified range, load-bank elements operate at not more than 50 percent of maximum continuous temperature rating of resistance elements.
- D. Load-Element Switching: Remote-controlled contactors switch groups of load elements. Contactor coils are rated 120 V. Contactors shall be located in a separate NEMA 250, Type 3R enclosure within load-bank enclosure, accessible from exterior through hinged doors with tumbler locks.
- E. Contactor Enclosures: Heated by thermostatically controlled strip heaters to prevent condensation.
- F. Load-Bank Enclosures: NEMA 250, Type 3R, aluminized steel complying with NEMA ICS 6. Louvers at cooling-air intake and discharge openings shall prevent entry of rain and snow. Openings for airflow shall be screened with 1/2-inch-square, galvanized-steel mesh. Reactive load bank shall include automatic shutters at air intake and discharge. Components other than resistive elements shall receive exterior epoxy coating with compatible primer. Comply with requirements in Section 099600 "High-Performance Coatings."
- G. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure.

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Cooling airflow and overtemperature sensors shall automatically shut down and lock out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000-A interrupting capacity.

- H. Load-Bank Remote-Control Panel: Separate from load bank in NEMA 250, Type 1 enclosure with a control power switch and pilot light, and switches controlling groups of load elements.
- I. Control Sequence: Control panel may be preset for adjustable single-step loading of generator during automatic exercising.

2.10 OUTDOOR ENGINE GENERATOR ENCLOSURE

- A. Description:
  - 1. Vandal-resistant, sound-attenuating, weatherproof steel housing; wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
  - 2. Prefabricated or pre-engineered, galvanized-steel-clad, integral structural-steel-framed; erected on concrete foundation.
- B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph.
- C. Hinged Doors: With padlocking provisions.
- D. Space Heater: Thermostatically controlled and sized to prevent condensation.
- E. Lighting: Provide weather-resistant LED lighting with 30 fc average maintained.
- F. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.
- G. Muffler Location: Within enclosure.
- H. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.
  - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Stormproof and drainable louvers prevent entry of rain and snow.
  - 2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
  - 3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.
- I. Interior Lights with Switch: Factory-wired, vapor-proof luminaires within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.



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1. AC lighting system and connection point for operation when remote source is available.
2. DC lighting system for operation when remote source and generator are both unavailable.

J. Convenience Outlets: Factory-wired, GFCI. Arrange for external electrical connection.

2.11 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
1. Material: Standard neoprene separated by steel shims.
  2. Minimum Deflection: 1 inch.
- B. Comply with requirements in Section 233113 "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.
- C. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.12 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.13 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
1. Tests: Comply with IEEE 115 and with NFPA 110, Level 1 Energy Converters.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
  2. Test generator, exciter, and voltage regulator as a unit.
  3. Full load run.
  4. Maximum power.
  5. Voltage regulation.
  6. Transient and steady-state governing.
  7. Single-step load pickup.
  8. Safety shutdown.
  9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
  10. Report factory test results within 10 days of completion of test.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.
- C. Equipment Mounting:
  - 1. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

3.3 CONNECTIONS

- A. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow space for service and maintenance.
- B. Connect cooling-system water piping to engine generator and heat exchanger with flexible connectors.
- C. Connect engine exhaust pipe to engine with flexible connector.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.
- F. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

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3.4 IDENTIFICATION

- A. Identify system components according to Section 260553 "Identification for Electrical Systems."
- B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency:
  - 1. Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
  - 2. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
  - 1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.
    - a. Visual and Mechanical Inspection:
      - 1) Compare equipment nameplate data with Drawings and the Specifications.
      - 2) Inspect physical and mechanical condition.
      - 3) Inspect anchorage, alignment, and grounding.
      - 4) Verify that the unit is clean.
    - b. Electrical and Mechanical Tests:
      - 1) Perform insulation-resistance tests according to IEEE 43.
        - a) Machines Larger Than 200 hp: Test duration shall be 10 minutes. Calculate polarization index.
        - b) Machines 200 hp or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.
      - 2) Test protective relay devices.
      - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
      - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
      - 5) Perform vibration test for each main bearing cap.
      - 6) Verify correct functioning of the governor and regulator.
  - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
  - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

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- a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    - c. Verify acceptance of charge for each element of the battery after discharge.
    - d. Verify that measurements are within manufacturer's specifications.
  4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
  5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
  6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
  7. Exhaust Emissions Test: Comply with applicable government test criteria.
  8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
  9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
  10. Noise Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet from edge of the generator enclosure, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

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3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION

## SECTION 263600 - TRANSFER SWITCHES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Contactor-type automatic transfer switches.
2. Molded-case-type automatic transfer switches.
3. Transfer switch accessories.

#### 1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

B. Product Data:

1. Contactor-type automatic transfer switches.
2. Molded-case-type automatic transfer switches.
3. Transfer switch accessories.

C. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

D. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.

B. Qualification Data: For manufacturer-authorized service representative and testing agency.

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- C. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Features and operating sequences, both automatic and manual.
    - b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

#### 1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.
- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

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1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
  2. Short-time withstand capability for 30 cycles.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- K. Service-Rated Transfer Switch:
1. Comply with UL 869A and UL 489.
  2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
  3. In systems with a neutral, the bonding connection shall be on the neutral bus.
  4. Provide removable link for temporary separation of the service and load grounded conductors.
  5. Surge Protective Device: Service rated.
  6. Ground-Fault Protection: Comply with UL 1008 for normal and alternative buses.
  7. Service Disconnecting Means: Externally operated, manual electrically actuated.
- L. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- M. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- N. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.
- O. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- P. Battery Charger: For generator starting batteries.
1. Float type, rated 10 A.
  2. Ammeter to display charging current.
  3. Fused ac inputs and dc outputs.
- Q. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- R. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations.



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Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
  3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
  4. Accessible via front access.
- S. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## 2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. ABB, Electrification Business.
  2. ASCO Power Technologies.
  3. Caterpillar, Inc.; Electric Power Division.
  4. Cummins Power Generation.
  5. Eaton.
  6. Generac.
  7. Hubbell Utility Solutions; Hubbell Incorporated.
  8. Kohler Power Systems.
  9. Rolls-Royce Solutions America Inc.
  10. Russelectric, Inc.
  11. Vertiv; Vertiv Holdings Co.
- B. Comply with Level 1 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
  2. Switch Action: Double throw; mechanically held in both directions.
  3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
  4. Conductor Connectors: Suitable for use with conductor material and sizes.
  5. Material: Hard-drawn copper, 98 percent conductivity.
  6. Main and Neutral Lugs: Mechanical type.
  7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  8. Ground bar.
  9. Connectors shall be marked for conductor size and type according to UL 1008.
- D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.

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1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. Automatic Transfer-Switch Controller Features:
  1. Controller operates through a period of loss of control power.
  2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
  4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
  5. Test Switch: Simulate normal-source failure.
  6. Switch-Position Pilot Lights: Indicate source to which load is connected.
  7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
  8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
  9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
  10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
  11. Engine Shutdown Contacts:
    - a. Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
    - b. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
  12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30

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minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

- a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
- b. Push-button programming control with digital display of settings.
- c. Integral battery operation of time switch when normal control power is unavailable.

H. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.
3. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

2.3 MOLDED-CASE-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB, Electrification Business.
2. Caterpillar, Inc.; Electric Power Division.
3. Cummins Power Generation.
4. Eaton.
5. Emerson Electric Co., Automation Solutions.
6. Generac.
7. Kohler Power Systems.
8. Lake Shore Electric Corporation.

- B. Comply with Level 1 equipment according to NFPA 110.

- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using contactor-based components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching.

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4. Conductor Connectors: Suitable for use with conductor material and sizes.
  5. Material: Hard-drawn copper, 98 percent conductivity.
  6. Main and Neutral Lugs: Mechanical type.
  7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  8. Ground bar.
  9. Connectors shall be marked for conductor size and type according to UL 1008.
- D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- E. Electric Nonautomatic Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- F. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- G. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- H. Transfer Switches Based on Molded-Case-Switch Components: Comply with UL 489 and UL 869A.
- I. Automatic Transfer-Switch Controller Features:
1. Controller operates through a period of loss of control power.
  2. Undervoltage Sensing for Each Phase of Normal and Alternative Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
  4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
  5. Test Switch: Simulate normal-source failure.
  6. Switch-Position Pilot Lights: Indicate source to which load is connected.
  7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
  8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

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9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts:
  - a. Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
  - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
  - b. Push-button programming control with digital display of settings.
  - c. Integral battery operation of time switch when normal control power is unavailable.

J. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.
3. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

2.4 TRANSFER SWITCH ACCESSORIES

A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the

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following features for each combined automatic transfer switch and bypass/isolation switch:

- a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
  - b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
  - c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
  - d. Transition:
    - 1) Provide closed-transition operation when transferring from main transfer switch to bypass/isolation switch on the same power source.
    - 2) Provide open-transition operation when transferring between power sources.
  - e. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
  - f. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
  - g. Automatic and Nonautomatic Control: Automatic transfer-switch controller shall also control the bypass/isolation switch.
  - h. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
  - i. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

B. Control System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Include the following functions for indicated transfer switches:
  - a. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
  - b. Indication of switch position.
  - c. Indication of switch in test mode.
  - d. Indication of failure of digital communication link.
  - e. Key-switch or user-code access to control functions of panel.
  - f. Control of switch-test initiation.
  - g. Control of switch operation in either direction.
  - h. Control of time-delay bypass for transfer to normal source.
3. Malfunction of control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically shall revert to standalone, self-contained operation.

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Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.

4. Control Panel: Solid-state components. Include the following features:
  - a. Controls and indicating lights grouped together for each transfer switch.
  - b. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
  - c. Digital Communication Capability: Matched to that of transfer switches supervised.
  - d. Mounting: Flush, modular, steel cabinet unless otherwise indicated.

## 2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
  1. For each of the tests required by UL 1008, performed on representative devices, for systems. Include results of test for the following conditions:
    - a. Overvoltage.
    - b. Undervoltage.
    - c. Loss of supply voltage.
    - d. Reduction of supply voltage.
    - e. Alternative supply voltage or frequency is at minimum acceptable values.
    - f. Temperature rise.
    - g. Dielectric voltage-withstand; before and after short-circuit test.
    - h. Overload.
    - i. Contact opening.
    - j. Endurance.
    - k. Short circuit.
    - l. Short-time current capability.
    - m. Receptacle withstand capability.
    - n. Insulating base and supports damage.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
  1. Install transfer switches on cast-in-place concrete equipment base(s).
  2. Provide workspace and clearances required by NFPA 70.
- B. Control Panel Mounting: Flush in wall unless otherwise indicated.

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- C. Identify components according to Section 260553 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

### 3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, motor controls, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
  - 1. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Connect twisted pair cable according to Section 260523 "Control-Voltage Electrical Power Cables."
- G. Route and brace conductors according to manufacturer's written instructions and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.
- H. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

### 3.3 FIELD QUALITY CONTROL

- A. Adminstrant for Tests and Inspections:
  - 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
  - 2. Administer and perform tests and inspections with assistance of factory-authorized service representative.
- B. Tests and Inspections:



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1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:
  - a. Compare equipment nameplate data with Drawings and Specifications.
  - b. Inspect physical and mechanical condition.
  - c. Inspect anchorage, alignment, grounding, and required clearances.
  - d. Verify that the unit is clean.
  - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
  - f. Verify that manual transfer warnings are attached and visible.
  - g. Verify tightness of all control connections.
  - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
    - 1) Use of low-resistance ohmmeter.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
  - i. Perform manual transfer operation.
  - j. Verify positive mechanical interlocking between normal and alternate sources.
  - k. Perform visual and mechanical inspection of surge arresters.
  - l. Inspect control power transformers.
    - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
    - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
    - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
3. Electrical Tests:
  - a. Perform insulation-resistance tests on all control wiring with respect to ground.
  - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
  - c. Verify settings and operation of control devices.
  - d. Calibrate and set all relays and timers.
  - e. Verify phase rotation, phasing, and synchronized operation.
  - f. Perform automatic transfer tests.
  - g. Verify correct operation and timing of the following functions:
    - 1) Normal source voltage-sensing and frequency-sensing relays.
    - 2) Engine start sequence.
    - 3) Time delay on transfer.
    - 4) Alternative source voltage-sensing and frequency-sensing relays.
    - 5) Automatic transfer operation.
    - 6) Interlocks and limit switch function.
    - 7) Time delay and retransfer on normal power restoration.
    - 8) Engine cool-down and shutdown feature.

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4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
    - a. Check for electrical continuity of circuits and for short circuits.
    - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    - c. Verify that manual transfer warnings are properly placed.
    - d. Perform manual transfer operation.
  5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
    - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
    - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    - c. Verify time-delay settings.
    - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
    - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
  6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
    - a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Transfer switches will be considered defective if they do not pass tests and inspections.
- F. Remove and replace malfunctioning units and retest as specified above.
- G. Prepare test and inspection reports.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

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- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

## SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Lightning protection system for ordinary structures.

#### 1.2 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each product.
- C. Shop Drawings:
  - 1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
  - 2. Include raceway locations needed for the installation of conductors.
  - 3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
  - 4. Include roof attachment details, coordinated with roof installation.
  - 5. Calculations required by NFPA 780 for bonding of metal bodies.
- D. Delegated Design Submittal: In addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineers responsible for their preparation.
  - 1. Drawings showing location of each device, and installation details as need to comply with listing conditions of device.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Lightning protection cabling attachments to roofing systems and accessories.
  - 2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.
  - 3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.

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- C. Qualification Data: For Installer.
- D. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.
- E. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For lightning protection system to include in maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations. Comply with requirements of Section 017839 "Project Record Documents."
    - b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.
- C. Completion Certificate:
  - 1. UL Master Label Certificate.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: UL-listed installer, category OWAY or LPI Master Installer.

### PART 2 - PRODUCTS

#### 2.1 LIGHTNING PROTECTION FOR STRUCTURES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ERICO; brand of nVent Electrical plc.
  - 2. East Coast Lightning Equipment Inc.
  - 3. Harger Lightning & Grounding; business of Harger, Inc.
  - 4. Heary Bros. Lightning Protection Co. Inc.
  - 5. Independent Protection Co.
  - 6. National Lightning Protection.
  - 7. Preferred Lightning Protection.
  - 8. Robbins Lightning, Inc.
  - 9. Thompson Lightning Protection, Inc.
  - 10. VFC Lightning Protection.

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11. allG Fabrication (formerly ALT).

2.2 PERFORMANCE REQUIREMENTS

- A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.
- B. UL Lightning Protection Standard: Comply with UL 96A requirements for Class I buildings.
- C. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

2.3 MATERIALS

- A. Air Terminals:
  - 1. Aluminum unless otherwise indicated.
  - 2. 3/8-inch diameter by 10 inches long.
  - 3. Pointed tip.
  - 4. Integral base support.
- B. Air Terminal Bracing:
  - 1. Aluminum.
  - 2. 1/4-inch diameter rod.
- C. Class I Main Conductors:
  - 1. Stranded Copper: 27,400 circular mils in diameter.
- D. Secondary Conductors:
  - 1. Aluminum: 41,400 circular mils in diameter.
- E. Ground Rods:
  - 1. Material: Copper-clad steel.
- F. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.

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- C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed installations in UL 96A.
  - 1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
  - 2. Install conduit where necessary to comply with conductor concealment requirements.
  - 3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
- D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

### 3.2 CONNECTIONS

- A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.
- B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: exothermic weld.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

### 3.3 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Perform inspections as required to obtain a UL Master Label for system.
  - 2. Perform inspections to obtain an LPI certification.
- B. Prepare test and inspection reports and certificates.

END OF SECTION

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SECTION 264313 – SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER  
CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.



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1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or repair SPDs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ABB USA.
  - 2. Advanced Protection Technologies Inc. (APT).
  - 3. Eaton.
  - 4. Emerson Electric Co.
  - 5. GE Zenith Controls.
  - 6. LEA International.

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7. [Leviton Manufacturing Co., Inc.](#)
8. PowerLogics, Inc.
9. [Schneider Electric USA, Inc.](#)
10. [SIEMENS Industry, Inc.; Energy Management Division.](#)

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1 and Type 2, as indicated.

1. SPDs with the following features and accessories:
  - a. Integral disconnect switch.
  - b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
  - c. Indicator light display for protection status.
  - d. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
  - e. Surge counter.

C. Comply with UL 1283.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480/277 V and 208Y/120 V as indicated, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V, 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 208Y/120 V, 1200 V for 480Y/277 V.
3. Line to Line: 1000 V for 208Y/120 V, 2000 V for 480Y/277 V.

F. SCCR: Equal or exceed 100 kA.

G. Inominal Rating: 20 kA.

## 2.3 PANEL SUPPRESSORS

A. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. [ABB USA.](#)
2. [Advanced Protection Technologies Inc. \(APT\).](#)
3. [Eaton.](#)
4. Emerson Electric Co.
5. GE Zenith Controls.
6. [LEA International.](#)
7. [Leviton Manufacturing Co., Inc.](#)

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8. PowerLogics, Inc.
9. [Schneider Electric USA, Inc.](#)
10. [SIEMENS Industry, Inc.; Energy Management Division.](#)

B. SPDs: Comply with UL 1449, Type 1.

1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Comply with UL 1283.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480/277 V and 208/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V, 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 208Y/120 V, 1200 V for 480Y/277 V.
3. Neutral to Ground: 1200 V for 208Y/120 V, 1200 V for 480Y/277 V.
4. Line to Line: 1000 V for 208Y/120 V, 2000 V for 480Y/277 V.

F. SCCR: Equal or exceed 100 kA.

G. Inominal Rating: 20 kA.

## 2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

## 2.5 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260523 "Control Voltage Electrical Power Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260523 "Control Voltage Electrical Power Cables."

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
  - 1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
  - 2. Controls: Comply with wiring methods in Section 260523 "Control Voltage Electrical Power Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
  - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
  - 2. Inspect anchorage, alignment, grounding, and clearances.
  - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

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3.4 DEMONSTRATION

- A. Train maintenance personnel to operate and maintain SPDs.

END OF SECTION

## SECTION 265000 - LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Luminaires.
2. Luminaire fittings.

B. Related Requirements:

1. Section 018116 "Facility Environmental Requirements" specifies basis-of-design environmental conditions and performance criteria that are applicable to product selection and installation of the Work on the Project.
2. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.
3. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260523 "Control-Voltage Electrical Power Cables" specifies wiring connections installed by this Section.
4. Section 260529 "Hangers and Supports for Electrical Systems" specifies channel and angle supports installed by this Section.
5. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.
6. Section 260923 "Lighting Control Devices" specifies automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors installed by this Section.

#### 1.2 DEFINITIONS

- A. BUG Rating: Backlight, uplight, and glare rating for light pollution from exterior luminaires.
- B. Correlated Color Temperature (CCT): The absolute temperature (in kelvins) of a blackbody whose chromaticity (color quality) most nearly resembles that of the light source.
- C. Color Rendering Index (CRI): The measure of the degree of color shift objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference light source. The lower the CRI of a light source, the more difficult it is to identify colors and stripes on electronic components and wiring.
- D. IDA: International Dark-Sky Association.
- E. IES: Illuminating Engineering Society.
- F. LPD: Lighting power density.

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1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Luminaires: Include the following additional information:
    - a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
      - 1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
      - 2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
      - 3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.
    - b. Product Certificates: Include product certificates stating compliance with standards listed below, signed by manufacturer or fabricator.
      - 1) Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with current accreditation under National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
      - 2) Testing Agency Certified Data: For luminaires indicated on Lighting Fixture Schedule on the Drawings, photometric data certified by qualified independent testing laboratory. Photometric data for remaining luminaires must be certified by manufacturer.
    - c. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
    - d. Include operating characteristics, electrical characteristics, and furnished accessories.
    - e. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on the Drawings.
    - f. Include battery and charger data for emergency lighting units.
    - g. Include ballast factor.
    - h. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
    - i. Include photometric data and adjustment factors obtained from qualified laboratory tests.
    - j. Include manufacturer's sample warranty language.
  - 2. Luminaire Fittings: Include the following additional information:

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- a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
    - 1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
    - 2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
    - 3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.
  - b. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - c. Include operating characteristics, electrical characteristics, and furnished accessories.
  - d. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on the Drawings.
  - e. Include manufacturer's sample warranty language.
- C. Shop Drawings: Prepare and submit the following:
1. Drawings, Diagrams, and Supporting Documents for Custom Luminaires:
    - a. Include plans, elevations, sections, and mounting and attachment details.
    - b. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    - c. Include diagrams for power, signal, and control wiring.
- D. Sustainable Design Submittals:
1. Product data for sustainable design features for each type of product.
  2. ASHRAE/IES 90.1 LPD Compliance Documentation: Prepare plans and calculations demonstrating that as-constructed lighting power density complies with mandatory provisions of ASHRAE/IES 90.1 and that as-constructed lighting, including daylighting and controls, improves on baseline energy performance. If included with the Project, indicate locations of energy meters for lighting loads.
- E. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Manufacturers' published instructions.



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C. Field Reports:

1. Manufacturer's field reports for field quality-control support.
2. Manufacturer's field reports for system startup support.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Warranty documentation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect exposed surface finishes on lighting equipment by applying strippable, temporary protective covering before shipping.

1.7 WARRANTY FOR LUMINAIRES

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that luminaires perform in accordance with specified requirements and agrees to provide repair or replacement of products that fail to perform as specified within extended-warranty period.
  1. Extended-Warranty Period: Five years from date of Substantial Completion; full coverage for labor, materials, and equipment.

1.8 WARRANTY FOR BATTERIES

- A. Special Manufacturer Extended Warranty for Batteries: Manufacturer warrants that batteries perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within extended-warranty period.
  1. Initial Extended-Warranty Period for Li-ion Batteries: Three years from date of Substantial Completion; full coverage for materials only, free on board origin, freight prepaid.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

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- B. Provide products listed in lighting fixtures schedule. Fixtures in schedule are basis of design. Alternate fixtures are acceptable provided the alternate meets the performance and aesthetic standards of the basis of design.

2.2 LUMINAIRES

A. Luminaire:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Albeo; brand of GE Current, a Daintree company; American Industrial Partners (AIP).
  - b. Alera Lighting; brand of GE Current, a Daintree company; American Industrial Partners (AIP).
  - c. Amerlux.
  - d. Architectural Area Lighting; brand of GE Current, a Daintree company; American Industrial Partners (AIP).
  - e. Atlas Lighting Products.
  - f. Columbia Lighting; brand of GE Current, a Daintree company; American Industrial Partners (AIP).
  - g. Cooper Lighting Solutions; Signify North America Corp.
  - h. Deco Lighting.
  - i. Digital Lumens.
  - j. E-conolight.
  - k. Kim Lighting; brand of GE Current, a Daintree company; American Industrial Partners (AIP).
  - l. LMPG Inc.
  - m. Lighting Services, Inc.
  - n. Lightolier; brand of Signify North America Corp.
  - o. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - p. Luraline Lighting.
  - q. OSRAM SYLVANIA.
  - r. Philips; Signify North America; Signify Holding.
  - s. Pure Lighting Manufacturing Ltd.
  - t. PureEdge Lighting.
  - u. RAB Lighting.
  - v. Selux Corporation.
  - w. Specialty Lighting Industries, Inc.
  - x. Visa Lighting.
  - y. West Durable Lighting.
  - z. Zumtobel Lighting, Inc.; Zumtobel Group.
2. Listing Criteria:
  - a. LED Luminaires: UL CCN IFAM; including UL 1598.
  - b. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.
3. Luminaire Description: .
4. Standard Features:

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- a. Openings: Doors, frames, and access panels must operate smoothly, not leak light under operating conditions, and permit relamping without use of tools or parts falling from enclosure.
  - b. Nominal Operating Voltage: 120 V(ac) 277 V(ac).
  - c. CRI: 80+.
  - d. Ballast or Driver Location: Internal Remote.
  - e. LED Luminaires (UL CCN IFAM):
    - 1) Output Intensity: As indicated in lighting fixture schedule.
    - 2) Rated Life: 50 000 hours to L70.
    - 3) CCT: As indicated in lighting fixture schedule.
5. Sustainable Design Features:
- a. Mercury Content: For fluorescent, mercury vapor, metal halide, high-pressure-sodium, neon, and argon lamps, submit data indicating mercury content and lamp life.
  - b. Backlight, Uplight, and Glare (BUG) Ratings: Exterior luminaire meets IES LM-11 recommended BUG ratings at luminaire's intended location.
  - c. IDA/IES Five Principles Ready:
    - 1) Exterior luminaire is adjustable to illuminate only to extent necessary for its intended purpose.
    - 2) Exterior luminaire is aimable.
    - 3) Exterior luminaire is dimmable.
    - 4) Exterior luminaire is controllable to turn on only when needed.
    - 5) Exterior luminaire has warm color temperature.
  - d. Corporate Sustainability Report: Third-party verified corporate sustainability report is publicly available from manufacturer, which includes environmental impacts of extraction operations and activities associated with product and its supply chain.
  - e. Regional Materials (LEED): Provide documentation if product is sourced (extracted, manufactured, purchased) within 100 mi of the Project site.
- B. UL FTBR or FTBV - Emergency Lighting and Power Equipment:
- 1. Standard Features:
    - a. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
    - b. Status and Test Indication: Visible and accessible without opening luminaire or entering ceiling space.
      - 1) Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
      - 2) Test Push-Button: Push-to-test button in unit housing simulates loss of normal power and demonstrates unit operability.
    - c. Nominal Operating Voltage: 120 V(ac) 277 V(ac).
    - d. Mounting: Wall with universal junction box adaptor.

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2. Sustainable Design Features:

- a. Mercury Content: For fluorescent, mercury vapor, metal halide, high-pressure-sodium, neon, and argon lamps, submit data indicating mercury content and lamp life.
- b. Corporate Sustainability Report: Third-party verified corporate sustainability report is publicly available from manufacturer, which includes environmental impacts of extraction operations and activities associated with product and its supply chain.
- c. Regional Materials (LEED): Provide documentation if product is sourced (extracted, manufactured, purchased) within 100 mi of the Project site.

3. Other Available Features Required by the Project:

- a. External-Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
  - 1) Emergency Connection: Operate continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire driver.
  - 2) Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - 3) Battery Type: Ni-Cd.
  - 4) Charger: Fully automatic, solid-state, constant-current type.
  - 5) Housing: Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly must be located no less than half of distance recommended by driver manufacturer, whichever is less.
  - 6) Test Push-Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - 7) LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 8) Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

C. UL FWBO - Exit Fixture:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Amerlux.
  - b. Cooper Lighting Solutions; Signify North America Corp.
  - c. Evenlite, Inc.
  - d. Hubbell Lighting; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - f. Philips; Signify North America; Signify Holding.

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2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria:
  - a. Exit Fixtures: UL CCN FWBO; including UL 924, NFPA 101, NFPA 5000, and ICC IBC.
  - b. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.
4. Standard Features:
  - a. Nominal Operating Voltage: 120 V(ac) 277 V(ac).
  - b. Light Source: LED; 50,000 hours minimum rated life.
  - c. Legend Color: Red.
  - d. Internal emergency power unit.
  - e. Battery Type: Ni-Cd.
5. Sustainable Design Features:
  - a. Mercury Content: For fluorescent, mercury vapor, metal halide, high-pressure-sodium, neon, and argon lamps, submit data indicating mercury content and lamp life.
  - b. Corporate Sustainability Report: Third-party verified corporate sustainability report is publicly available from manufacturer, which includes environmental impacts of extraction operations and activities associated with product and its supply chain.
  - c. Regional Materials (LEED): Provide documentation if product is sourced (extracted, manufactured, purchased) within 100 mi of the Project site.

## 2.3 LUMINAIRE FITTINGS

### A. Luminaire Support Accessories:

1. Standard Features:
  - a. Sized and rated for luminaire weight.
  - b. Capable of maintaining luminaire position after cleaning and relamping.
  - c. Capable of supporting luminaire without causing deflection of ceiling or wall.
  - d. Capable of supporting horizontal force equal to 100 percent of luminaire weight and vertical force equal to 400 percent of luminaire weight.
2. Sustainable Design Features:
  - a. Corporate Sustainability Report: Third-party verified corporate sustainability report is publicly available from manufacturer, which includes environmental impacts of extraction operations and activities associated with product and its supply chain.
  - b. Regional Materials (LEED): Provide documentation if product is sourced (extracted, manufactured, purchased) within 100 mi of the Project site.
3. Other Available Features Required by the Project:

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- a. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage wire supports adjustable in length.
- b. Aircraft Cables: 5/32 inch diameter aircraft cable supports adjustable to in length.
- c. Single-Stem Hangers: 1/2 inch nominal diameter steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- d. Rod Hangers: 3/16 inch nominal diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF LIGHTING

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
  - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
  - 2. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
  - 3. Work in Confined Spaces: NFPA 350.
  - 4. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
  - 5. Installation of Indoor Lighting Systems: NECA NEIS 500.
  - 6. Installation of Exterior Lighting Systems: NECA NEIS 501.
  - 7. Installation of Luminaires, Lampholders, and Lamps: Article 410 of NFPA 70.
  - 8. Installation of Lighting for Sensitive Electronic Equipment: Article 647 of NFPA 70.
  - 9. Installation of Emergency Lighting and Exit Signs: ICC IBC, NFPA 101, and Parts IV and V in Article 700 of NFPA 70.
  - 10. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
  - 1. Install luminaires level, plumb, and square with finished floor or grade unless otherwise indicated.
  - 2. Install luminaires at height and aiming angle as indicated on the Drawings.
  - 3. Coordinate layout and installation of luminaires with other construction.
  - 4. Exterior Bollard and Pole Mounted Luminaires:
    - a. Align units for optimum directional alignment of light distribution.
    - b. Refer to civil drawings for site fixture installation details.

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5. Exterior Corrosion Prevention:
  - a. Do not use aluminum in contact with earth or concrete. When in direct contact with dissimilar metals, protect aluminum with insulating fittings or treatment.
  - b. When embedding steel conduits in concrete, wrap conduit with 10 mil thick, pipe-wrapping plastic tape applied with a 50 percent overlap.
6. Flush-Mounted Luminaire Support:
  - a. Secured to outlet box.
  - b. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  - c. Trim ring flush with finished surface.
7. Wall-Mounted Luminaire Support: Attached to structural members in walls.
  - a. Do not attach luminaires directly to gypsum board.
8. Suspended Luminaire Support:
  - a. Ceiling Mount:
    - 1) Two wires.
    - 2) Two aircraft cables.
  - b. Pendants and Rods: Where longer than 48 inch, brace to limit swinging.
  - c. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  - d. Continuous Rows of Luminaires: Provide tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
  - e. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
9. Ceiling-Grid-Mounted Luminaire Support:
  - a. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inch from luminaire corners.
  - b. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for application.
  - c. Luminaires of Sizes Smaller than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with no fewer than two 3/4 inch metal channels spanning and secured to ceiling tees.
10. Remote Mounting of Ballasts or Drivers: Do not exceed distance between ballast or driver and luminaire recommended by ballast or driver manufacturer.
11. Emergency Power Units: Secure with approved fasteners in four or more locations, spaced near corners of unit.
12. Install wiring connections for luminaires.

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13. Identification: Provide labels for luminaires and associated electrical equipment.

- a. Identify field-installed conductors, interconnecting wiring, and components.
- b. Provide warning signs.
- c. Label each enclosure with engraved metal or laminated-plastic nameplate.

D. Systems Integration: Integrate lighting control devices and equipment with electrical power connections for operation of luminaires as specified.

### 3.3 FIELD QUALITY CONTROL OF LIGHTING

A. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
3. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
4. Verify operation of photoelectric controls.
5. Exterior Illumination Tests:
  - a. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.

B. Nonconforming Work:

1. Luminaire will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

### 3.4 SYSTEM STARTUP

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's published instructions.
2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

### 3.5 ADJUSTING

A. Luminaire Aiming Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aiming direction of luminaires to suit occupied conditions. Make up to two visits to the Project's site during other-than-normal hours for this purpose. Some of the Work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.



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2. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
3. Adjust aim of luminaires in presence of Architect.

3.6 CLOSEOUT ACTIVITIES

A. Training:

1. Train Owner's maintenance personnel on the following topics:
  - a. How to adjust, operate, and maintain luminaires.

3.7 PROTECTION

- A. After installation, protect lighting equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

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SECTION 265613 - LIGHTING POLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Poles and accessories for support of luminaires.

1.3 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete luminaire.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
  - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
  - 2. Include finishes for lighting poles and luminaire-supporting devices.
  - 3. Anchor bolts.
  - 4. Manufactured pole foundations.
- C. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

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3. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
4. Anchor bolt templates keyed to specific poles and certified by manufacturer.
5. Method and procedure of pole installation. Include manufacturer's written installations.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.
- C. Material Test Reports:
  1. For each foundation component, by a qualified testing agency.
  2. For each pole, by a qualified testing agency.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranty: Manufacturer's standard warranty.
- G. Soil test reports

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

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1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Substantial Completion.
2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STEEL AND ALUMINUM POLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work are limited to the following:

1. American LitePole.
2. Bridgwell Resources.
3. E-conolight.
4. EGS/Appleton Electric.
5. H.E. Williams.
6. Hapco.
7. Hubbell Incorporated.
8. KIM Lighting.
9. LSI Industries.
10. Millerbernd Manufacturing Company.
11. NAFCO International.
12. Ruud Lighting Direct.
13. Union Metal Corporation.

- B. Source Limitations: Obtain poles from single manufacturer or producer. Pole must be compatible with exterior LED fixtures. Pole must match existing Lithonia site poles.

- C. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

- D. Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.

1. Shape: Round, tapered.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

- E. Post Top: Fabricated to support luminaire or luminaires and securely fastened to pole top.

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- F. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
  - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- H. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- I. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.
- J. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
  - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high gloss, high-build polyurethane enamel.
    - a. Color: As selected by Architect from manufacturer's full range.
- K. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Powder Coat: Comply with AAMA 2604.
    - a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
    - b. Color: As selected by Architect from manufacturer's full range.
- L. Provide factory installed vibration damper.

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2.2 POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.3 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
  - 2. Threading: Uniform National Coarse, Class 2A.
- B. Nuts: ASTM A 563, Grade A, Heavy-Hex
  - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
  - 2. Two nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.
- C. Washers: ASTM F 436, Type 1.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
  - 2. One washers provided per anchor bolt.

2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 POLE FOUNDATION

- A. Refer to civil drawings for mounting details.
- B. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.3 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
- B. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole unless otherwise indicated.
  - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Perform the following special inspections:
  - 1. Inspect poles for nicks, mars, dents, scratches, and other damage.
  - 2. System function tests.

END OF SECTION

## SECTION 265619 – LED EXTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
  - 2. Luminaire supports.
- B. Related Requirements:
  - 1. Section 265613 "Lighting Poles" for poles and standards used to support exterior lighting equipment.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of luminaire.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.



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3. Include physical description and dimensions of luminaire.
  4. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  5. Photometric data and adjustment factors based on laboratory tests, complying with IES LM-79, IES LM-80.
    - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
  6. Wiring diagrams for power, control, and signal wiring.
  7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
  2. Structural members to which luminaires will be attached.
  3. Underground utilities and structures.
  4. Existing underground utilities and structures.
  5. Above-grade utilities and structures.
  6. Existing above-grade utilities and structures.
  7. Building features.
  8. Vertical and horizontal information.
- C. Product Certificates: For each type of the following:
1. Luminaire.
- D. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Source quality-control reports.
- F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
  - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.9 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including luminaire support components.
    - b. Faulty operation of luminaires and accessories.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: 2 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. UL Compliance: Comply with UL 1598 and listed for wet location.
- D. CRI of minimum 80. CCT of 3000 K.
- E. L70 lamp life of 60,000 hours.
- F. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- G. Internal driver.
- H. Nominal Operating Voltage: 277 V ac. Verify voltage in field.
- I. In-line Fusing: On the primary for each luminaire.
- J. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LUMINAIRE TYPES

- A. Provide light fixtures in lighting fixture schedule to match existing site fixtures.

2.3 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum, stainless steel, or epoxy-coated steel. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:

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1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  2. Glass: Annealed crystal glass unless otherwise indicated.
  3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
1. White Surfaces: 85 percent.
  2. Specular Surfaces: 83 percent.
  3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage and coating.
    - c. CCT and CRI for all luminaires.

## 2.4 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust.
  2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

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- a. Color: As selected by Architect from manufacturer's full range during submittal review.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls and roofs for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Support luminaires without causing deflection of finished surface.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Refer to Civil drawings for bollard installation detail.
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

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- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming.
- K. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and Section 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
    - a. IES LM-5.
    - b. IES LM-50.
    - c. IES LM-52.
    - d. IES LM-64.
    - e. IES LM-72.
  - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.

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- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
  - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

## SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Backboards.
  - 2. Boxes, enclosures, and cabinets.
- B. Related Requirements:
  - 1. Section 260536 "Cable Trays for Electrical Systems" for cable trays and accessories.
  - 2. Section 260526 "Grounding and Bonding for Electrical Systems."

#### 1.3 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- D. TGB: Telecommunications grounding bus bar.
- E. TMGB: Telecommunications main grounding bus bar.

#### 1.4 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.



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- C. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
  - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

PART 2 - PRODUCTS

2.1 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.
- B. Backboard Paint: Light-colored grey fire-retardant paint.

2.2 GROUND BUS

- A. Provide TMGB and TGB in communications rooms.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.
- D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

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E. Backboards:

1. Install from 6 inches to 8 feet, 6 inches above finished floor. Ensure that fire-rating stamp is visible after installation.
2. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.
3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

3.2 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices" Ch.

END OF SECTION

## SECTION 281400 - ACCESS CONTROL SYSTEM HARDWARE

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Access control system units.
2. Access control system power supplies and battery chargers.
3. Access control system supplementary computer equipment.

B. Related Requirements:

1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
2. Section 281500 "Integrated Access Control Hardware Devices" for access control field devices controlled by hardware specified in this Section.

#### 1.2 DEFINITIONS

- A. DGP: Data gathering panel.
- B. LAN: Local area network.
- C. RAID: Redundant array of inexpensive disks; redundant array of independent disks.
- D. RAM: Random-access memory.
- E. WAN: Wide area network.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Coordination Meeting(s): For access control system hardware. Conduct meeting(s) as videoconference or at Project site before.
1. Attendees: Installers, fabricators, representatives of manufacturers, representatives from telecommunications, Owner's security representatives, IT representatives, and administrators for field tests and inspections. Notify Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.

#### 1.4 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

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B. Product Data:

1. Access control system units.
2. Access control system power supplies and battery chargers.
3. Access control system supplementary computer equipment.

C. Shop Drawings:

1. Project general notes.
2. Hardware and equipment locations.
3. Block diagram and cable/conduit routing.
4. System communications details.
5. Hardware and equipment installation details.
6. Secondary power calculations.

D. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Installation instructions for access control system servers.
2. Installation instructions for access control system DGPs.
3. Installation instructions for access control system input/output interface.
4. Installation instructions for access control system door controllers.
5. Installation instructions for access control system workstation.
6. Manufacturer's recommended testing and inspection procedure for operation of access control system servers, panels, input/output interfaces, door controllers, and workstations.
7. Installation instructions for access control system power supplies and battery chargers.
8. Manufacturer's recommended testing and inspection procedure for operation of access control system power supplies and battery chargers.
9. Installation instructions for access control system printers.
10. Manufacturer's recommended testing and inspection procedure for operation of access control system printers.

C. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.

B. Warranty documentation.

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1.7 WARRANTY FOR ACCESS CONTROL SYSTEM HARDWARE

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that access control system hardware perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
  - 1. Initial Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

1.8 WARRANTY FOR BATTERIES

- A. Special Manufacturer Extended Warranty for Batteries: Manufacturer warrants that batteries perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within extended-warranty period.
  - 1. Initial Extended-Warranty Period for Li-ion Batteries: Three years from date of Substantial Completion; full coverage for materials only, free on board destination, freight prepaid.

PART 2 - PRODUCTS

2.1 ACCESS CONTROL SYSTEM UNITS

- A. Description: This category covers head end units for access control systems, providing a means of regulating or controlling physical entry into an area, or access to or use of device by electrical, electronic, and/or mechanical means. Access control systems are investigated as complete configuration based upon manufacturer's specified system components. Access control systems are intended to comply with applicable life safety access and egress requirements.
- B. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70 and NFPA 72, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
    - b. Comply with NFPA 1, NFPA 730, NFPA 731, and ICC IBC.
  - 2. Listing Criteria: UL CCN ALVY; including UL 294.
- C. Access Control System Server: The Access Control/Security and DVM System shall be an extension of the existing Honeywell Enterprise Building Integrator System with host server hardware located in Augusta, ME.
  - 1. Accessories:
    - a. Provide Lantronix UDS1100 with 500-171-R to RS485 screw terminal adapter.

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D. Access Control System DGPs: Altronix AL1024ULACM8.

1. Source Limitations: Obtain products from.
2. Additional Characteristics:
  - a. Data ports for connection to LAN and downstream DGPs.
  - b. Integral terminal blocks secured to enclosure.
  - c. Enclosure lock with tamper switch and monitoring.
3. Options:
  - a. Input Voltage: 120 V(ac).
  - b. Battery Backup: 12 V.
  - c. DGP Communication: Ethernet TIA-485 or composite.
  - d. Mounting: Wall mount or rack mount.

E. Access Control System Door Controllers: Altronix AL1024ULACM8.

1. Source Limitations: Obtain products from single manufacturer.
2. Additional Characteristics:
  - a. Data ports for connection to LAN and downstream controllers.
  - b. Integral terminal blocks for connection of inputs/outputs to field devices.
  - c. Controller Inputs:
    - 1) Auxiliary input.
    - 2) Door contact.
    - 3) Cabinet tamper.
    - 4) Power monitor.
  - d. Controller Outputs:
    - 1) Auxiliary output.
    - 2) Door strike.
    - 3) Door operators.
    - 4) Credential readers.
3. Options:
  - a. Input Voltage: 12 to 24 V(dc).
  - b. Controller Communication: Ethernet TIA-232 TIA-485 or composite.
  - c. Mounting: Cabinet mount or wall.

F. Access Control System Input/Output Interface: Altronix.

1. Source Limitations: Obtain products from single manufacturer.
2. Additional Characteristics:
  - a. Input Voltage: 12 to 24 V(dc).
  - b. Data ports for connection to LAN and downstream panels/controllers.
  - c. Integral terminal blocks for connection of inputs/outputs to field devices.
  - d. Inputs:

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- 1) Auxiliary inputs from building systems.
- 2) Door contact.
- 3) Cabinet tamper.
- 4) Power monitor.

e. Outputs:

- 1) Auxiliary outputs to building systems.
- 2) Door strike.
- 3) Credential readers.
- 4) Audible devices.

3. Options:

- a. Communication: Ethernet TIA-232 TIA-485 or composite.
- b. Mounting: Cabinet mount or wall.

2.2 ACCESS CONTROL SYSTEM POWER SUPPLIES AND BATTERY CHARGERS

A. Description: This category covers power supplies and battery chargers for access control system units, controllers, input/output interfaces, workstations, printers, and encoders.

B. Performance Criteria:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70 and NFPA 72, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- b. Comply with NFPA 1, NFPA 730, NFPA 731, and ICC IBC.

2. Listing Criteria: UL CCN ALVY; including UL 294.

C. Access Control System Power Supply and Battery Charger:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Altronix Corp.
- b. Honeywell Commercial Security; Honeywell International, Inc.

2. Source Limitations: Obtain products from single manufacturer.

3. Additional Characteristics:

- a. Input Voltage: 120 V(ac).
- b. Output Voltage: 12 to 24 V(dc).
- c. Network connection for remote supervision, management, and testing.
- d. Enclosure lock with tamper switch and monitoring.
- e. Built-in battery charger.

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- 4. Accessories:
  - a. DIN rails for mounting.

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESS CONTROL SYSTEM HARDWARE

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
  - 1. Installation of Access Control System Hardware and Wiring: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with requirements in guide information for UL CCN ALVY.
  - 2. Consult Architect and Owner for resolution of conflicting requirements.
- C. Interfaces with Other Work:
  - 1. Coordinate installation of new products for access control system hardware with existing conditions.

3.2 FIELD QUALITY CONTROL OF ACCESS CONTROL SYSTEM HARDWARE

- A. Acceptance Testing Preparation:
  - 1. Prepare manufacturers recommended tests and reports. Perform tests and generator reports.
- B. Field tests and inspections must be witnessed by Architect authorities having jurisdiction.
- C. Tests and Inspections:
  - 1. Perform manufacturer's recommended tests and inspections.
- D. Nonconforming Work:
  - 1. Hardware and components will be considered defective if they do not pass tests and inspections.
  - 2. Remove and replace defective units and retest.
- E. Collect, assemble, and submit test and inspection reports.
- F. Manufacturer Services:
  - 1. Engage factory-authorized service representative to perform field tests and inspections.



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3.3 SYSTEM STARTUP

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's published instructions.

3.4 PROTECTION

- A. After installation, protect access control system hardware from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 281500 - INTEGRATED ACCESS CONTROL HARDWARE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated credential readers and entry management.
2. Access control credentials.
3. Electrified locking devices and accessories.
4. Egress management devices.
5. Access control remote devices.
6. Electronic key management systems.

1.2 DEFINITIONS

- A. NFC: Near Field Communications.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Coordination Meeting(s): For integrated access control hardware devices. Conduct meeting(s) as videoconference or at Project site before.
1. Attendees: Installers, fabricators, representatives of manufacturers, representatives from telecommunications, Owner's security representatives, IT representatives, and administrators for field tests and inspections. Notify Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.

1.4 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Product Data:
1. Integrated Credential Readers and Entry Management:
    - a. Credential readers.
    - b. Keypads.
    - c. Combination reader devices.
  2. Access Control Credentials:
    - a. Access control cards.

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3. Electrified Locking Devices and Accessories:
    - a. Electrically controlled single-point locks and latches.
    - b. Electrically controlled two- and three-point locks and latches.
    - c. High-security electronic locks.
    - d. Status monitoring and egress devices.
  4. Egress Management Devices:
    - a. Panic hardware with special locking arrangement.
    - b. Fire-exit hardware with special locking arrangement.
  5. Access Control Remote Devices:
    - a. NFC access control devices.
  6. Electronic Key Management Systems:
    - a. Electronic key management system units.
- C. Shop Drawings:
1. Project general notes.
  2. Device layout.
  3. Block diagram and cable/conduit routing.
  4. System communications details.
  5. System mounting details.
  6. Secondary power calculations.
- D. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
1. Installation instructions for integrated credential readers and entry management devices.
  2. Manufacturer's recommended tests and inspections for integrated credential readers and entry management devices.
  3. Printing, programming, and handling instructions for access control credentials.
  4. Installation instructions for electrified locking devices and accessories.
  5. Manufacturer's recommended tests and inspections for electrified locking devices and accessories.
  6. Installation instructions for egress management devices.
  7. Manufacturer's recommended tests and inspections for egress management devices.
  8. Installation instructions for access control remote devices.
  9. Manufacturer's recommended tests and inspections for access control remote devices.
  10. Installation instructions for electronic key management systems.

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11. Manufacturer's recommended tests and inspections for electronic key management systems.

- C. Sample warranties.

## 1.6 CLOSEOUT SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Maintenance Contracts:
  1. Software and firmware service agreements.
- C. Warranty documentation.

## 1.7 WARRANTY

- A. Integrated Credential Readers and Entry Management Devices Warranty:
  1. Special Manufacturer Extended Warranty: Manufacturer warrants that integrated credential readers and entry management devices perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
    - a. Initial Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.
- B. Electrified Locking Devices and Accessories Warranty:
  1. Special Manufacturer Extended Warranty: Manufacturer warrants that electrified locking devices and accessories perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
    - a. Initial Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

## PART 2 - PRODUCTS

### 2.1 INTEGRATED CREDENTIAL READERS AND ENTRY MANAGEMENT

- A. Swipe Card Reader:
  1. Provide HID Signo Priority Seos Profile Reader, Model 20, 20k, 40, 40k.
    - a. 40NKS-02-000000.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
  - 1. Cable Type: Shielded.
  - 2. Analog Maximum Cable Length: 1000 ft.
  - 3. Digital Maximum Cable Length: 300 ft.
- C. Interfaces with Other Work:
  - 1. Coordinate access control credentials with integrated credential readers and access control system architecture.
  - 2. Egress Management Interfaces:
    - a. Coordinate with Section 282000 "Video Surveillance" for automatic video feed callup upon delayed egress activation.

3.2 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by Architect and authorities having jurisdiction.
- B. Tests and Inspections:
  - 1. Perform manufacturer's recommended tests and inspections.
- C. Nonconforming Work:
  - 1. Device will be considered defective if it does not pass tests and inspections.
  - 2. Remove and replace defective units and retest.
- D. Collect, assemble, and submit test and inspection reports.
- E. Manufacturer Services:
  - 1. Engage factory-authorized service representative to perform field tests and inspections.

3.3 PROTECTION

- A. After installation, protect integrated access control hardware devices from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

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SECTION 282000 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes a video surveillance system consisting of cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment.
- B. Related Requirements:
  - 1. Section 283100 "Intrusion Detection" to integrate video surveillance used for intrusion detection.

1.3 DEFINITIONS

- A. AGC: Automatic gain control.
- B. BNC: Bayonet Neill-Concelman - type of connector.
- C. B/W: Black and white.
- D. CCD: Charge-coupled device.
- E. FTP: File transfer protocol.
- F. IP: Internet protocol.
- G. LAN: Local area network.
- H. MPEG: Moving picture experts group.
- I. NTSC: National Television System Committee.
- J. PC: Personal computer.
- K. PTZ: Pan-tilt-zoom.
- L. RAID: Redundant array of independent disks.
- M. TCP: Transmission control protocol - connects hosts on the Internet.
- N. UPS: Uninterruptible power supply.

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- O. WAN: Wide area network.

#### 1.4 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- C. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
  - 3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
  - 4. UPS: Sizing calculations.
  - 5. Wiring Diagrams: For power, signal, and control wiring.
- D. Design Data: Include an equipment list consisting of every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Field quality-control reports.
- C. Product Warranty: Sample of special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

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1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
  1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
  2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
  3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick. Use NEMA 250, Type 3R enclosures.
  4. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.
- C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.



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2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NECA 1.
- C. Comply with NFPA 70.
- D. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

2.3 CAMERAS

- A. Provide Axis Cameras with Motion Detection:
  - 1. Refer to Camera Schedule on Drawings.

2.4 POWER SUPPLIES

- A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera, infrared illuminator, and lens.
  - 1. Enclosure: NEMA 250, Type 1.

2.5 CAMERA-SUPPORTING EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Bosch Security Systems, Inc.
  - 2. CBC (AMERICA) Corp.
  - 3. COP-USA.
  - 4. Crest Electronics, Inc.
  - 5. ELMO.
  - 6. Elbex Ltd.
  - 7. EverFocus Electronics Corporation.
  - 8. Honeywell Commercial Security; Honeywell International, Inc.
  - 9. Ikegami Electronics (USA) Inc.
  - 10. Interlogix; Carrier Global Corporation.
  - 11. Merit Li-Lin (USA) Corp.
  - 12. Moog, Inc.
  - 13. Panasonic Corporation of North America.
  - 14. Pelco.
  - 15. SANYO North America Corporation.
  - 16. Samsung Opto-Electronics.
  - 17. Telpix Electronics, Inc.

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18. [Tyco Security Products; brand of Johnson Controls International plc, Building Solutions North America.](#)
19. [Vicon Industries, Inc.](#)
20. [Video Mount Products.](#)
21. [Visiontech.](#)
22. [Wren Associates Limited.](#)

- B. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.
- C. Pan Units: Motorized automatic-scanning units arranged to provide remote-controlled manual and automatic camera panning action, and equipped with matching mounting brackets.
1. Scanning Operation: Silent, smooth, and positive.
  2. Stops: Adjustable without disassembly, to limit the scanning arc.
- D. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation, and equipped with matching mounting brackets.
1. Panning Rotation: 0 to 355 degrees, with adjustable stops.
  2. Tilt Movement: 90 degrees, plus or minus 5 degrees, with adjustable stops.
  3. Speed: 12 degrees per second in both horizontal and vertical planes.
  4. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.
  5. Built-in encoders or potentiometers for position feedback, and thermostat-controlled heater.
  6. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.
- E. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.

## 2.6 IP VIDEO SYSTEMS

- A. The System shall be an extension of the existing Honeywell Enterprise Building Integrator System with host server hardware located in Augusta, ME.
- B. Cameras must connect to the LAN and terminate in the Honeywell Digital Video Manager.
- C. Provide CAT6 cable. Terminate with RJ45 jack using EIA/TIA568B standard.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.

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- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 WIRING

- A. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems."
- B. Wiring Method: Install cables in raceways unless otherwise indicated.
  - 1. Except raceways are not required in accessible indoor ceiling spaces and attics.
  - 2. Except raceways are not required in hollow gypsum board partitions.
  - 3. Conceal raceways and wiring except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. For communication wiring, comply with the following:
  - 1. Section 271513 "Communications Copper Horizontal Cabling."
- F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

### 3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras and infrared illuminators level and plumb.
- B. Install cameras with 84-inch-minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.
- C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.
- D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.
- E. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.
- F. Avoid ground loops by making ground connections only at the control station.
  - 1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.

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3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
  - 2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
    - a. Prepare equipment list described in "Informational Submittals" Article.
    - b. Verify operation of auto-iris lenses.
    - c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
    - d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
    - e. Set and name all preset positions; consult Owner's personnel.
    - f. Set sensitivity of motion detection.
    - g. Connect and verify responses to alarms.
    - h. Verify operation of control-station equipment.
  - 3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
  - 4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- D. Video surveillance system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to

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two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
3. Adjust all preset positions; consult Owner's personnel.
4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.6 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION

## SECTION 283100 - INTRUSION DETECTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Intrusion detection with communication links to perform monitoring, alarm, and control functions.
  - 2. Integration of other electronic and electrical systems and equipment.

- B. Related Sections:

- 1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for power cabling between master control units and field-mounted devices and control units.
  - 2. Section 282000 "Video Surveillance" for CCTV cameras that are used as devices for video motion detection.

#### 1.3 DEFINITIONS

- A. CCTV: Closed-circuit television.
- B. PIR: Passive infrared.
- C. RFI: Radio-frequency interference.
- D. UPS: Uninterruptible power supply.
- E. Control Unit: System component that monitors inputs and controls outputs through various circuits.
- F. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.
- G. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.
- H. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.

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- I. Standard Intruder: A person who weighs 100 lb or less and whose height is 60 inches or less; dressed in a long-sleeved shirt, slacks, and shoes.
- J. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.
- K. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.
- L. Zone. A defined area within a protected premises. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

1.4 ACTION SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Product Data: Components for sensing, detecting, systems integration, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- C. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.
  - 1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify networks control interface devices and media to be used. Describe characteristics of network and other data communication lines.
    - a. Indicate methods used to achieve systems integration.
    - b. Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.
    - c. Describe characteristics of network and other data communication lines.
    - d. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.
  - 2. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection and for systems integration. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.
  - 3. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building. Include room layout for master control-unit console, terminal cabinet and racks.
  - 4. Master Control-Unit Console Layout: Show required artwork and device identification.
  - 5. Device Address List: Coordinate with final system programming.

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- 6. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
  - 7. Details of surge-protection devices and their installation.
  - 8. Sensor detection patterns and adjustment ranges.
- D. Design Data: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.
- E. Samples for Initial Selection: For units with factory-applied color finishes.
- F. Samples for Verification: For each type of exposed finish required.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Qualification Data: For Installer intrusion detection systems integrator testing agency.
- C. Field quality-control reports.
  - 1. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
- D. Product Warranty: Sample of special warranty.
- E. Field Test Reports: Test plan and report defining all tests required to ensure that system meets technical, operational, and performance specifications within 60 days of date of Contract award.
- F. Evaluation Reports: Examination reports documenting inspections of substrates, areas, and conditions.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals must comply with the requirements of the Construction Contract Clauses, Section 013300 "Submittal Procedures" and the individual Sections specifying the work.
- B. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Data for each type of product, including features and operating sequences, both automatic and manual.
  - 2. Master control-unit hardware and software data.



## 1.7 QUALITY ASSURANCE

### A. Installer Qualifications:

1. An employer of workers, at least one of whom is a Certified Alarm Technician, Level 1.
2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
3. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings by a Technician.
4. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
5. Testing Supervisor: Currently certified by BICSI as a Technician to supervise on-site testing.

### B. Intrusion Detection Systems Integrator Qualifications: An experienced intrusion detection equipment supplier and Installer who has completed systems integration work for installations similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

1. At least one of whom is a Certified Systems Integrator.

### C. Testing Agency Qualifications: Certified by BICSI.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

## 1.8 PROJECT CONDITIONS

### A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Altitude: Sea level to 4000 feet.
2. Master Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
3. Interior, Controlled Environment: System components, except master control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
4. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambients of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
5. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambients of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Comply with UL 294 and UL 639 for outdoor-use equipment. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick.

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1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Description: Modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
- B. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.
2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.
3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or control unit.
- C. System Control: Master control unit shall directly monitor intrusion detection units and connecting wiring.
- D. System Control: Master control unit shall directly monitor intrusion detection devices, perimeter detection units, and connecting wiring in a multiplexed distributed control system or as part of a network.
- E. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
- F. Operator Commands:
1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
5. Protected Zone Test: Initiate operational test of a specific protected zone.
6. System Test: Initiate system-wide operational test.
7. Print reports.

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- G. Timed Control at Master Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.
- H. Automatic Control of Related Systems: Alarm or supervisory signals from certain intrusion detection devices control the following functions in related systems:
  - 1. Switch selected lights.
  - 2. Switch signal to selected monitor from CCTV camera in vicinity of sensor signaling an alarm.
- I. Printed Record of Events: Print a record of alarm, supervisory, and trouble events on system printer. Sort and report by protected zone, device, and function. When master control unit receives a signal, print a report of alarm, supervisory, or trouble condition. Report type of signal (alarm, supervisory, or trouble), protected zone description, date, and time of occurrence. Differentiate alarm signals from other indications. When system is reset, report reset event with the same information concerning device, location, date, and time. Commands shall initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
- J. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.
- K. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.
- L. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.
- M. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

## 2.2 SYSTEM COMPONENT REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.
- C. FM Global Compliance: FM-Approved and -labeled intrusion detection devices and equipment.
- D. Comply with NFPA 70.

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- E. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the following equipment:
  - 1. Door hardware specified in Section 087111 "Door Hardware."
  - 2. Video surveillance system specified in Section 282000 "Video Surveillance."
- F. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
  - 1. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.
- G. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.
- H. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.
- I. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.
- J. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to master control unit.
- K. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to master control unit as an alarm signal.
- L. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master control unit.
- M. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at master control unit for calibration, sensitivity, and alarm condition.

2.3 ENCLOSURES

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
- B. Interior Electronics: NEMA 250, Type 12.
- C. Exterior Electronics: NEMA 250, Type 4X, stainless steel.

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- D. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

## 2.4 SECURE AND ACCESS DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Bosch Security Systems, Inc.
  - 2. Corby Industries, Inc.
  - 3. Crow Electronic Engineering, Inc.
  - 4. DAQ Electronics, Inc.
  - 5. Digital Security Controls Ltd.
  - 6. Edwards; Carrier Global Corporation.
  - 7. Honeywell International Inc.
  - 8. Visonic Inc.
- B. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.
- C. Key-Operated Switch: Change protected zone between secure and access conditions.

## 2.5 DOOR SWITCHES

- A. Provide:
  - 1. GE Interlogix – 1078C
  - 2. GE Interlogix – 1085T
  - 3. GE Interlogix – 1045T
  - 4. GE Interlogix – 2315A-L (overhead doors)
  - 5. GE Interlogix – 3010 (panel tamper)
  - 6. GE Interlogix – 3012 (panel tamper)
  - 7. GRI TRC-20 (panel tamper)
- B. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.

## 2.6 PIR SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Aleph America Corporation.
  - 2. Bosch Security Systems, Inc.
  - 3. Crow Electronic Engineering, Inc.
  - 4. Digital Security Controls Ltd.
  - 5. Honeywell International Inc.

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6. [Interlogix; Carrier Global Corporation.](#)
  7. [Visonic Inc.](#)
- B. Listed and labeled by a qualified testing agency for compliance with SIA PIR-01.
- C. Description: Sensors detect intrusion by monitoring infrared wavelengths emitted from a human body within their protected zone and by being insensitive to general thermal variations.
1. Wall-Mounted Unit Maximum Detection Range: 125 percent of indicated distance for individual units and not less than 50 feet.
  2. Ceiling-Mounted Unit Spot-Detection Pattern: Full 360-degree conical.
  3. Ceiling-Mounted Unit Pattern Size: 84-inch diameter at floor level for units mounted 96 inches above floor; 18-foot diameter at floor level for units mounted 25 feet above floor.
- D. Device Performance:
1. Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps across two adjacent segments of detector's field of view.
  2. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.
  3. Remote Test: When initiated by master control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

## 2.7 SECURITY FASTENERS

- A. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.
- D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.

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1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
  2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.
- E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SYSTEM INTEGRATION

- A. Integrate intrusion detection system with the following systems and equipment:

1. Electronic door hardware.
2. Access control.
3. Video surveillance.

### 3.3 SYSTEM INSTALLATION

- A. Comply with UL 681 and NFPA 731.
- B. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
- C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- D. Security Fasteners: Where accessible to inmates, install intrusion detection components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in stainless-steel materials.

### 3.4 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceways according to Section 260533.13 "Conduits for Electrical Systems," except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal

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according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Wires and Cables:

1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.
2. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable, according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
4. Data and Television Signal Transmission Cables: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

G. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 270553 "Identification for Communications Systems."

### 3.5 IDENTIFICATION

A. Install instructions frame in a location visible from master control unit.

### 3.6 GROUNDING

A. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.

### 3.7 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.



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1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."
  1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
  2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."
- E. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."
- F. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

END OF SECTION

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Duct smoke detectors.
6. Carbon monoxide detectors.
7. Heat detectors.
8. Fire-alarm notification appliances.
9. Fire-alarm remote annunciators.
10. Fire-alarm addressable interface devices.

B. Related Requirements:

1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).
- E. NICET: National Institute for Certification in Engineering Technologies.
- F. PC: Personal computer.
- G. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

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1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Division 01 Section “Submittal Procedures” and the individual sections specifying the work.
- B. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction after submitting them to Architect for initial review.
- C. Product Data: For each type of product, including furnished options and accessories.
  1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  2. Include rated capacities, operating characteristics, and electrical characteristics.
- D. Shop Drawings: For fire-alarm system.
  1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
  2. Include plans, elevations, sections, and details, including details of attachments to other Work.
  3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
  4. Annunciator panel details.
  5. Detail assembly and support requirements.
  6. Include voltage drop calculations for notification-appliance circuits.
  7. Include battery-size calculations.
  8. Include input/output matrix.
  9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
  10. Include performance parameters and installation details for each detector.
  11. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- E. Delegated Design Submittal: For notification appliances and smoke detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.
  1. Drawings showing location of each notification appliance, smoke detector, carbon monoxide detector, pull stations, ratings of each, and installation details as needed to comply with listing conditions of device.

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2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Division 01 Section "Submittal Procedures" and the individual sections specifying the work.
- B. Field quality-control reports.
- C. Qualification Statements: For Installer.
- D. Sample Warranty: Submittal must include line item pricing for replacement parts and labor.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Division 01 Section "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
    - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
    - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
    - d. Riser diagram.
    - e. Device addresses.
    - f. Record copy of site-specific software.
    - g. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      - 1) Equipment tested.
      - 2) Frequency of testing of installed components.
      - 3) Frequency of inspection of installed components.
      - 4) Requirements and recommendations related to results of maintenance.
      - 5) Manufacturer's user training manuals.
    - h. Manufacturer's required maintenance related to system warranty requirements.
    - i. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

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C. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media and approved online or cloud solution.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Submittals shall comply with the requirements of Division 01 Section “Submittal Procedures” and the individual sections specifying the work.
- B. Extra Stock Material: For each location, furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
  2. Smoke Detectors, Heat Detectors, and Carbon Monoxide Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
  3. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
  4. Keys and Tools: One extra set for access to locked or tamperproofed components.
  5. Audible and Visual Notification Appliances: One of each type installed.
  6. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
  2. Installation must be by personnel certified by NICET as fire-alarm Level III or Level IV technician.
  3. Obtain certification by NRTL in accordance with NFPA 72.
  4. Licensed or certified by authorities having jurisdiction.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 ADDRESSABLE FIRE-ALARM SYSTEM

#### A. Description:

1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.

#### B. Performance Criteria:

##### 1. Regulatory Requirements:

- a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 and NFPA 72 for use with selected fire-alarm system and marked for intended location and application.

##### 2. General Characteristics:

- a. Automatic sensitivity control of certain smoke detectors.
- b. Fire-alarm signal initiation must be by one or more of the following devices and systems:
  - 1) Manual stations.
  - 2) Heat detectors.
  - 3) Smoke detectors.
  - 4) Duct smoke detectors.
  - 5) Carbon monoxide detectors.
  - 6) Automatic sprinkler system water flow.
  - 7) Dry system pressure flow switch.
- c. Fire-alarm signal must initiate the following actions:
  - 1) Continuously operate alarm notification appliances.
  - 2) Identify alarm and specific initiating device at FACU, connected network control panels, off-premises network control panels, and remote annunciators.
  - 3) Transmit alarm signal to remote alarm receiving station.
  - 4) Unlock electric door locks in designated egress paths.
  - 5) Switch HVAC equipment controls to fire-alarm mode.
  - 6) Close smoke dampers in air ducts of designated air-conditioning duct systems.
  - 7) Recall elevators to primary or alternate recall floors.
  - 8) Activate elevator power shunt trip.
  - 9) Activate emergency lighting control.
  - 10) Record events in system memory.
- d. Supervisory signal initiation must be by one or more of the following devices and actions:
  - 1) Valve supervisory switch.

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- 2) High- or low-air-pressure switch of dry-pipe sprinkler system.
  - 3) Elevator shunt-trip supervision.
  - 4) Independent fire-detection and -suppression systems.
  - 5) Zones or individual devices have been disabled.
  - 6) FACU has lost communication with network.
- e. System trouble signal initiation must be by one or more of the following devices and actions:
- 1) Open circuits, shorts, and grounds in designated circuits.
  - 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  - 4) Loss of primary power at FACU.
  - 5) Ground or single break in internal circuits of FACU.
  - 6) Abnormal ac voltage at FACU.
  - 7) Break in standby battery circuitry.
  - 8) Failure of battery charging.
  - 9) Abnormal position of switch at FACU or annunciator.
  - 10) Hose cabinet door open.
- f. System Supervisory Signal Actions:
- 1) Initiate notification appliances.
  - 2) Identify specific device initiating event at FACU, connected network control panels, off-premises network control panels, and remote annunciators.
  - 3) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
  - 4) Transmit system status to building management system.
- g. Network Communications:
- 1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
  - 2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.

## 2.2 FIRE-ALARM CONTROL UNIT (FACU)

- A. Manufacturers: Subject to compliance with requirements, provide products by Honeywell International, Inc. to match existing campus systems.
- B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- C. Performance Criteria:
1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
  2. General Characteristics:

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- a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
- b. Include real-time clock for time annotation of events on event recorder and printer.
- c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
- d. FACU must be listed for connection to central-station signaling system service.
- e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
- f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
  - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
- g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
  - 1) Annunciator and Display: LCD, 80 characters, minimum.
  - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- h. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
  - 1) Pathway Class Designations: NFPA 72, Class B.
  - 2) Pathway Survivability: Level 1.
  - 3) Install no more than 50 addressable devices on each signaling-line circuit.
  - 4) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
- i. Serial Interfaces:
  - 1) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
  - 2) One USB or RS 232 port for PC configuration.
- j. Notification-Appliance Circuit:
  - 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72. CO detectors must sound in temporal 4 pattern.
  - 2) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
- k. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station. Provide transmitter



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capable of being connected to the campus fiber optic loop. Connection to loop by others.

- l. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and transmitters must be powered by 24 V(dc) source.
- m. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
- n. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
- o. Batteries: Sealed lead calcium.

D. Accessories:

1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.

2.3 MANUAL FIRE-ALARM BOXES

- A. Manufacturers: Subject to compliance with requirements, provide products by Honeywell International, Inc. to match existing campus systems.
- B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
  1. Double-action mechanism requiring two actions to initiate alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
  2. Station Reset: Key- or wrench-operated switch. Comply with municipal fire department for each site.
  3. Material: Manual stations made of Lexan polycarbonate.
  4. Able to be used in indoor areas.
  5. Comply with city or town fire department requirements for each town, each system.

2.4 SYSTEM SMOKE DETECTORS

A. Photoelectric Smoke Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by Honeywell International, Inc. to match existing campus systems.
2. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
  - b. General Characteristics:

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- 1) Detectors must be four or two-wire type.
- 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
- 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
  - a) Primary status.
  - b) Device type.
  - c) Present average value.
  - d) Present sensitivity selected.
  - e) Sensor range (normal, dirty, etc.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 9) Color: White.
- 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
- 11) Multiple levels of detection sensitivity for each sensor.
- 12) Sensitivity levels based on time of day.

## 2.5 DUCT SMOKE DETECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. Honeywell International, Inc.
- B. Description: Photoelectric-type, duct-mounted smoke detector.
- C. Performance Criteria:
  1. Regulatory Requirements:
    - a. NFPA 72.
    - b. UL 268A.
  2. General Characteristics:
    - a. Detectors must be four-wire type.
    - b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.

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- c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- d. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- e. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- f. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
  - 1) Primary status.
  - 2) Device type.
  - 3) Present average value.
  - 4) Present sensitivity selected.
  - 5) Sensor range (normal, dirty, etc.).
- g. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
- h. Each sensor must have multiple levels of detection sensitivity.
- i. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
- j. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

## 2.6 CARBON MONOXIDE DETECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by Honeywell International, Inc. to match existing campus systems.
- B. Description: Carbon monoxide detector listed for connection to fire-alarm system.
- C. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. NFPA 72
    - b. NFPA 720.
    - c. UL 2075.
  - 2. General Characteristics:
    - a. Mounting: Adapter plate for outlet box mounting.
    - b. Testable by introducing test carbon monoxide into sensing cell.
    - c. Detector must provide alarm contacts and trouble contacts.
    - d. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
    - e. Locate, mount, and wire in accordance with manufacturer's written instructions.
    - f. Provide means for addressable connection to fire-alarm system.
    - g. Test button simulates alarm condition.

## 2.7 HEAT DETECTORS

### A. Combination-Type Heat Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Honeywell International, Inc.
2. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
    - 2) UL 521.
  - b. General Characteristics:
    - 1) Temperature sensors must test for and communicate sensitivity range of device.
  - c. Actuated by fixed temperature of 135 deg F or rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
  - d. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  - e. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
  - f. Detector must have functional humidity range of 10 to 90 percent relative humidity.
  - g. Color: White.

### B. Fixed-Temperature-Type Heat Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Honeywell International, Inc.
2. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
    - 2) UL 521.
  - b. General Characteristics:
    - 1) Actuated by temperature that exceeds fixed temperature of 190 deg F.
    - 2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
    - 3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
    - 4) Detector must have functional humidity range of 10 to 90 percent.
    - 5) Color: White.

## 2.8 FIRE-ALARM NOTIFICATION APPLIANCES

### A. Fire-Alarm Audible Notification Appliances:

1. Manufacturers: Subject to compliance with requirements, provide products by Honeywell International, Inc. to match existing campus systems.
2. Description: Horns that cannot output voice messages.
3. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
  - b. General Characteristics:
    - 1) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
    - 2) Audible notification appliances must have functional humidity range of 10 to 95 percent relative humidity.
    - 3) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. from horn, using coded signal prescribed in UL 464 test protocol.
    - 4) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

### B. Fire-Alarm Visible Notification Appliances:

1. Manufacturers: Subject to compliance with requirements, provide products by Honeywell International, Inc. to match existing campus systems.
2. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
    - 2) UL 1971.
  - b. General Characteristics:
    - 1) Rated Light Output:
      - a) 15/30/75/110 cd, selectable in field.
    - 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
    - 3) Mounting: Wall mounted unless otherwise indicated.
    - 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
    - 5) Flashing must be in temporal pattern, synchronized with other units.
    - 6) Strobe Leads: Factory connected to screw terminals.
    - 7) Mounting Faceplate: Factory finished, white. Labeled: Alert.

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2.9 FIRE-ALARM REMOTE ANNUNCIATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by Honeywell International, Inc. to match existing campus systems.
- B. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. NFPA 72.
  - 2. General Characteristics:
    - a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
      - 1) Mounting: Surface cabinet, NEMA 250, Type 1.
    - b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by Honeywell International, Inc. to match existing campus systems.
- B. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. NFPA 72.
  - 2. General Characteristics:
    - a. Include address-setting means on module.
    - b. Store internal identifying code for control panel use to identify module type.
    - c. Listed for controlling HVAC fan motor controllers.
    - d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
    - e. Control Module:
      - 1) Operate notification devices.
      - 2) Operate solenoids for use in sprinkler service.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service in accordance with requirements indicated:
  - 1. Notify Contract Administrator no fewer than twenty-one days in advance of proposed interruption of fire-alarm service.
  - 2. Do not proceed with interruption of fire-alarm service without Contract Administrator's written permission.
  - 3. Coordinate outages with local fire department. Comply with outage requirements.
- C. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

### 3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
  - 1. Devices are not permitted to be placed in service before other trades have completed cleanup.
  - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.

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C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
2. Mount manual fire-alarm box on background of contrasting color.
3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level. Devices must be mounted at same height unless otherwise indicated.

D. Smoke Detector Spacing:

1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat detector spacing.
3. Smooth ceiling spacing must not exceed 30 ft.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A or Annex B in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.

F. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

G. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn, or as a combination unit, and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.

I. Device Location-Indicating Lights: Locate in public space near device they monitor.

J. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

### 3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."



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- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate must be laminated acrylic or melamine plastic signs, red background with engraved white letters, as specified in Section 260553 "Identification for Electrical Systems."

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

### 3.6 PATHWAYS

- A. Pathways must be installed in EMT or ERMC-S in accordance with Section 260533.13 "Conduits for Electrical Systems."
- B. Exposed conduit and boxes must be painted red enamel.

### 3.7 CONNECTIONS

- A. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
  - 1. Supervisory connections at valve supervisory switches.

### 3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in location visible from FACU.

### 3.9 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.10 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by authorities having jurisdiction.
- B. Administrant for Tests and Inspections:
  - 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
    - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
  - 2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
  - 4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
  - 5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
  - 6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

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3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Provide video recording of training to Owner.

3.12 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION

SECTION 284816 - TWO-WAY EMERGENCY COMMUNICATIONS SYSTEMS FOR RESCUE ASSISTANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Two-way emergency communications system for rescue assistance.

B. Related Requirements:

1. Section 018123 "Facility Seismic and Wind Criteria" specifies basis-of-design seismic and wind criteria for nonstructural components on the Project.
2. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.
3. Section 078413 "Penetration Firestopping" specifies materials and methods for sealing penetrations of rated walls and partitions referenced by this Section.
4. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding referenced by this Section.
5. Section 260529 "Hangers and Supports for Electrical Systems" specifies hangers, supports, and concrete bases referenced by this Section.
6. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs referenced by this Section.
7. Section 260533.13 "Conduits for Electrical Systems" specifies additional requirements for raceway materials, routing, locations, and identification of communications equipment and cabling.
8. Section 284621.11 "Addressable Fire Alarm Systems" specifies fire-alarm cabling and interfacing two-way emergency communications systems with fire-alarm systems.

1.2 DEFINITIONS

- A. FCC: Fire Command Center.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product. In addition to information identified in Section 013300 "Submittal Procedures," submit the following:
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  2. Include operating characteristics, electrical characteristics, and furnished accessories.

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3. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
  - a. If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
  - b. Listing criteria identified in approval letter must match specified listing criteria. UL label indicating approval of equipment's enclosure is not considered approval of equipment for intended application.
  - c. Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for discontinued or superseded products are unacceptable for submitted product.
4. Include manufacturer's sample extended warranty language.
5. Product Certificates: Include product certificate stating compliance with NFPA 72, UL 2525, adopted building and fire codes, and specified requirements, signed by manufacturer or fabricator.

C. Shop Drawings: Prepare and submit the following:

1. Two-Way Emergency Communications Systems for Rescue Assistance Drawings, Diagrams, and Supporting Documents:
  - a. Project general notes.
  - b. Device layout.
  - c. Block diagrams and cable/conduit routing.
  - d. Pathway class and survivability identification.
  - e. System communications details.
  - f. System sequence of operations.
  - g. System mounting details.
  - h. Secondary power calculations.

D. Field quality control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Manufacturer's published instructions.
- C. System Record of Inspection and Testing: Record copy of completed system acceptance testing. Format must be approved by authorities having jurisdiction.
- D. Field Reports:
  1. Manufacturer's field reports for field quality-control support.
  2. Manufacturer's field reports for system startup support.
  3. Field reports for voltage monitoring and adjusting.
  4. Field reports for infrared scanning.
  5. Field reports for software and firmware upgrades.

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1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Warranty documentation.
- C. Maintenance service agreement.
- D. Software and firmware service agreement.

1.6 REGULATORY AGENCY APPROVALS

- A. Submittals for two-way emergency communications system for rescue assistance requiring approval by authorities having jurisdiction must be signed by qualified designer or professional engineer responsible for their preparation. Submit for action by Architect prior to submitting for approval by authorities having jurisdiction.

1.7 QUALIFICATIONS

- A. Communications Cable Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" and the following:
  - 1. Training and manufacturer certification to install, splice, and terminate communications cabling.
  - 2. Installation Supervisor: BICSI Technician (TECH) certification.
  - 3. Copper Installers: 30 percent of employees possess BICSI Copper Installer 2 (INSTC) certification. Remaining employees possess BICSI Installer 1 (INST1) certification.
  - 4. Fiber Installers: 30 percent of employees possess BICSI Optical Fiber Installer 2 (INSTF) certification. Remaining employees possess BICSI Installer 1 (INST1) certification.
- B. Communications Testing and Inspecting Agency: Entity possessing active credentials from qualified electrical testing laboratory recognized by authorities having jurisdiction.
  - 1. On-site communications testing supervisor must have BICSI Technician (TECH) certification and documented training, and be experienced with testing communications equipment in accordance with BICSI testing standards.
- C. Professional Engineer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in life-safety systems.

1.8 WARRANTY FOR TWO-WAY EMERGENCY COMMUNICATIONS SYSTEMS FOR RESCUE ASSISTANCE

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed two-way emergency communications system for rescue assistance performs in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period. Warranty must convey to Owner upon acceptance of the Work.

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1. Extended-Warranty Period: Four years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Description: Provide a two-way communication system at the landing serving each elevator on each floor. Comply with NFPA 101, Section 7.2.12.1.
- B. Performance Criteria:
  1. Regulatory Requirements:
    - a. Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
    - b. Unless otherwise indicated in the Contract Documents, products must comply with NFPA 1, NFPA 70, NFPA 72, NFPA 101, ICC IBC, and local regulations enforced by authorities having jurisdiction.

2.2 TWO-WAY EMERGENCY COMMUNICATIONS SYSTEM FOR RESCUE ASSISTANCE

- A. Description: This category includes equipment for providing two-way emergency voice communication for areas of refuge, elevator landings, and occupant evacuation elevator lobbies in accordance with NFPA 72 and adopted building and fire codes.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. Honeywell International Inc.
- C. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
  1. Emergency Communications Systems for Rescue Assistance: UL CCN UUKB, including UL 2525, NFPA 1, NFPA 70, NFPA 72, NFPA 101, ICC IBC, and ICC IFC.
- D. Standard Features:
  1. Master Control Station:
    - a. Power Supply: Power 120 V(ac) supply system including utility power, batteries, automatic float-charge battery charger, and automatic transfer switch.
    - b. Secondary power supply must be capable of operating the system under quiescent load for a minimum of 24 hours, and then subsequently during a fire or other emergency condition for a period of 4 hours with all remote call stations activated and all master control stations annunciating the calls.
    - c. Mounting: Flush.

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- d. Communicate between master control station and remote communications stations.
  - e. Annunciate visual and audible signal at master control station when remote two-way communication station call button has been pressed.
  - f. Silence audible signal when master control station handset is removed and remote telephone handset is acknowledged.
  - g. Display identification for location of remote communications stations in building.
- 2. Remote Communications Stations: Single-gang, stainless steel-plate, flush-mounted station with hands-free, two-way communication.
- E. Signage: Post directions for use of the two-way communication system, instructions for summoning assistance, and written identification of the location adjacent to the phone station.
- F. Signage detailing special accessibility provisions must be provided as shown below:
  - 1. Identify each door to an area of refuge from an adjacent floor with a sign stating: "AREA OF REFUGE."
  - 2. Identify each door to an exterior area for assisted rescue with a sign stating: "EXTERIOR AREA FOR ASSISTED RESCUE."
- G. Provide directional signage indicating the location of all other means of egress and which of those are accessible means of egress at the following:
  - 1. Exits serving a required accessible space, but not providing an approved accessible means of egress.
  - 2. Elevator landings.
  - 3. Within areas of refuge.
- H. Instructions: In areas of refuge and exterior areas for assisted rescue, post instructions on use of the area under emergency conditions showing special accessibility provisions. Signage complies with the ICC A117.1 requirements for visual characters. The instructions include all of the following:
  - 1. Persons able to use the exit stairway do so as soon as possible, unless assisting others.
  - 2. Information on planned availability of assistance in use of stairs or supervised operation of elevators on how to summon such assistance.
  - 3. Directions for use of the two-way communication system where provided.

PART 3 - EXECUTION

- 3.1 INSTALLATION OF TWO-WAY EMERGENCY COMMUNICATIONS SYSTEMS FOR RESCUE ASSISTANCE
  - A. Comply with manufacturer's published instructions.
  - B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
    - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.



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2. Electrical Maintenance: NFPA 70B.
3. Electrical Safety: NFPA 70E.
4. Fire-Alarm and Premises Security Work: NFPA 72, NFPA 731, and NECA NEIS 305.
5. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
6. Communications Work: BICSI N1.
7. Work in ITE Rooms: NFPA 75.
8. Work in Health Care Facilities: NFPA 99 and Article 517 of NFPA 70.
9. Life Safety and Means of Egress Work: NFPA 101.
10. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
11. Work in Confined Spaces: NFPA 350.
12. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
13. Evaluation of Unlabeled Electrical Equipment: NFPA 791.
14. Work in Museums, Libraries, Places of Worship, and Historic Structures: NFPA 909 and NFPA 914.
15. Fire-Alarm Circuits and Pathways: Ch. 12 of NFPA 72 and Article 760 of NFPA 70.
16. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Master Control Station: Mount in first floor elevator lobby to provide power, supervision, and control for two-way emergency communications systems for rescue assistance.
2. Installation for Survivability:
  - a. Where survivable pathways are indicated or required, install cables and pathways within 2-hour fire-resistance-rated enclosures or provide fire-resistive pathway installation in accordance with NFPA 72 Survivability Levels 2 or 3.
  - b. Install control equipment, power supplies, junction boxes, terminal cabinets, or similar components within dedicated 2-hour fire-resistance-rated equipment rooms if components originate from or comprise a portion of NFPA 72 Survivability Levels 2 or 3 pathways.
  - c. Riser Cables: Cables run between floors from the control point to terminal cabinets on floors above in accordance with NFPA 72 Survivability Level 1. Where required: 2-hour fire-resistive pathways in accordance with NFPA 72 Survivability Level 3.
  - d. Feeder Cables: Cables run from terminal cabinets to individual phone stations in accordance with NFPA 72 Survivability Level 1.
  - e. Fully Sprinklered Buildings: In accordance with NFPA 72 Survivability Level 3.
3. Wiring Methods:
  - a. Cabling:
    - 1) Category 5 Cable: Type CMR, nominal 0.205", 24 AWG, unshielded, twisted pairs, PVC jacket.
    - 2) Power-Limited Cable: Type CMP, nominal 0.151", 18 AWG, 2-conductor, unshielded, twisted pairs, PVC jacket.
    - 3) Connectors: ANSI/TIA-568-C, unscreened twisted pair (U/UTP), 8-position, 22 to 24 AWG.
4. Control Unit Grounding: Connect transformers, cabinets, and other equipment as specified by manufacturer, to electrical ground as provided by Division 26.

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5. Shielded Cable Grounding: Where used, shielded speaker cables to have their shield drain wire connected to ground at the control unit. At each phone station, shielded cables should trim drain wires flush with cable jacket and wrapped with several layers of electrical tape.

D. Interfaces with Other Work:

1. Identification: Provide labels for two-way communication and associated electrical equipment.
  - a. Identify field-installed conductors, interconnecting wiring, and components.
  - b. Label each enclosure with engraved metal or laminated-plastic nameplate.
2. Direct connection of Terminal Equipment (TE) to the Public Switched Telephone Network (PSTN).
  - a. 47 CFR 68.
3. Connection of control units with switches and routers as part of a local network.

E. Systems Integration:

1. Provide necessary supervised interfaces, between emergency communications systems and fire-alarm system, that perform in accordance with requirements of authorities having jurisdiction.

### 3.2 ANALOG VERSUS IP-BASED SYSTEMS

A. Analog Command Unit: The command unit will do the following:

1. Be an indoor-rated emergency communications system device comprised of a local command unit phone, a monitoring panel, a strobe/sounder, and an uninterruptible power supply (UPS).
2. Be half duplex in operation.
3. Be programmable through the local command unit phone.
4. Be programmable from a remote location if a connection to the public switched telephone network (PSTN) is made available.
5. Support and provide power to each analog call station for up to 8 units as an area of refuge (or area of rescue assistance) station used for emergency communications.
6. Provide analog call stations with the ability to establish communication with either an attendant at the local command unit phone or an attendant through a PSTN connection.
7. Provide an audible and visual indication of a system ground fault.
8. Provide an audible and visual indication of open faults and short faults that occur on an analog call station conductive pathway.
9. Have a monitoring panel that provides a visual indication on the activation status and trouble status of the analog call stations.

B. IP-Based Command Unit: The command unit will do the following:

1. Be an indoor-rated, Internet Protocol-based (IP-based) emergency communications system device comprised of an IP-based Private Branch Exchange (PBX), a local

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- command unit phone with extension modules, and a Power over Ethernet (PoE) injector.
- 2. Be full duplex in operation.
- 3. Be programmable through a local web browser.
- 4. Support up to 8 areas of refuge stations as an area of refuge (or area of rescue assistance) station used for emergency communications.
- 5. Provide area of refuge stations with the ability to establish communication with either an attendant at the local command unit phone or an attendant through a PSTN connection.
- 6. Provide an audible indication that an area of refuge station has been activated.
- 7. Provide a visual indication on the activation status of the area of refuge stations.

3.3 FIELD QUALITY CONTROL OF TWO-WAY EMERGENCY COMMUNICATIONS  
SYSTEM FOR RESCUE ASSISTANCE

A. Administrant for Tests and Inspections:

- 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

B. Field tests and inspections must be witnessed by authorities having jurisdiction.

C. Tests and Inspections:

- 1. Perform manufacturer's recommended tests and inspections.
- 2. Perform field tests and inspections required by NFPA 72.
- 3. Perform tests of communication from each remote station to the master control station at the central control point and/or FCC.
- 4. Perform tests of communication with remote supervising station if included.

D. Nonconforming Work:

- 1. Equipment will be considered defective if it does not pass tests and inspections.
- 2. Remove and replace defective units and retest.

E. Field Quality Control Reports: Collect, assemble, and submit test and inspection reports.

F. Manufacturer Services: Engage factory-authorized service representative to support field tests and inspections.

- 1. Manufacturer's Field Reports for Field Quality-Control Support: Prepare and submit report after each visit by factory-authorized service representative, documenting activities performed at the Project site.

3.4 SYSTEM STARTUP

A. Perform startup service.

- 1. Complete installation and startup checks in accordance with manufacturer's published instructions.

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2. Ensure the system is connected to a working analog phone line and that a valid central monitoring station account is active for this location and that the account is put on test until verbally removed from test.
3. Conduct system startup after all installation tasks have been completed.
4. Power on the central control unit and any accessories supplied from separate auxiliary power supplies. Check all Normal status LEDs and/or LCD panels for Normal status indications.
5. Remove Primary AC power from the central control unit. Within 90 seconds, the Normal LED should turn off or the Normal status on the LCD panel should be replaced with "AC Fault." Restore primary AC power.
6. Disconnect the backup battery from the central control unit. Within 90 seconds, the Trouble LED should turn on or the Normal status on the LCD panel should be replaced with "Battery Fault." Restore backup battery power.
7. Disconnect analog phone line from the central control unit. Within 90 seconds, the Trouble LED should turn on or the Normal status on the LCD panel should be replaced with "Phone Line Fault." Restore the analog phone line connection.
8. From the closest Area of Refuge (AOR) call station, press the emergency button. The red LED should flash as the system connects to the central control unit.
9. At the central control unit, verify the location of the calling station. Lift the handset and confirm the ability to talk to the person at the call station. Return the handset to its holder.
10. From the same call station, press the emergency button. The red LED should flash as the system connects to the central control unit. At the central control unit, do not answer the call but allow it to time out and be directed to the central monitoring station.
11. At the AOR call station, confirm the ability to talk to the central station operator and the correct address and location of the call station. This information should be sent automatically by the system. Conclude the call.
12. Repeat this sequence with each call box or an agreed to sample of call boxes.

B. Manufacturer Services: Engage factory-authorized service representative to support system startup.

1. Manufacturer's Field Reports for System Startup Support: Prepare and submit report after each visit by factory-authorized service representative, documenting activities performed at the Project site.

### 3.5 CLOSEOUT ACTIVITIES

- A. A one-year maintenance contract offering continued factory-authorized service of this system must be provided as part of this contract.
- B. Contractor to furnish manufacturer's manuals of the completed system including individual specifications sheets, schematics, and inter-panel and intra-panel wiring diagrams.
  1. All information necessary for proper maintenance and operation of the system must be included.
  2. Provide four copies.
- C. Submit as-built drawings that include changes to wiring, wiring designations, junction box labeling, and other pertinent information upon completion of the Project.

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D. Training:

1. With assistance from factory-authorized service representatives, train Owner's maintenance personnel on the following topics:
  - a. How to adjust, operate, and maintain system.

3.6 PROTECTION

- A. After installation, protect equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.7 MAINTENANCE

A. Software and Firmware Service Agreement:

1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software and firmware support for two years.
2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software and firmware upgrades that become available within two years from date of Substantial Completion. Verify that upgrading software includes operating system and new or revised licenses for using software.
  - a. Upgrade Notice: Not less than 30 days; to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.
3. Field Reports for Software and Firmware Upgrades: Prepare and submit report after each update, documenting upgrades installed.

END OF SECTION

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SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, removing site utilities, and abandoning site utilities in place.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

C. Related Requirements:

1. Section 01500 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

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- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction indicated on Drawings and according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
  - 1. Use sufficiently detailed photographs or video recordings.
  - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- C. Topsoil stripping and stockpiling program.
- D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

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2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Engage a private utility locator service and notify Dig Safe System and OK to Dig for area where Project is located before site clearing.
- C. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- D. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
  1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
  1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.



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- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
  - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect not less than five days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Owner's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
  - 3. Use only hand methods or air spade for grubbing within protection zones.
  - 4. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

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1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth indicated on Drawings in a manner to prevent intermingling with underlying subsoil or other waste materials.
  1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
  1. Limit height of topsoil stockpiles to 15 feet.
  2. Do not stockpile topsoil within protection zones.
  3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning tree, shrub, and other vegetation waste is not permitted.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

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SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Base course for concrete walks.
6. Subbase course and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 316329 "Micro Piles" for excavation of shafts and disposal of surplus excavated material.
3. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
4. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Section 012200 "Unit Prices."

B. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

1. 24 inches outside of concrete forms other than at footings.
2. 12 inches outside of concrete forms at footings.
3. 6 inches outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 12 inches beneath bottom of concrete slabs-on-grade.
6. 9 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

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1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
  - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving or the aggregate layer placed between the subgrade and walkways.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Crushed Stone/Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Drainage Course: Material placed around subsurface drainage piping to promote drainage of groundwater.
- G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
  - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices and changes in the Work.
  - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
  - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.
- H. Fill: Soil materials used to raise existing grades.
- I. MDOT: Maine Department of Transportation.
- J. Rock:
  - 1. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
    - a. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.

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- b. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.
- K. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.
- L. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement.
- M. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, topsoil materials, or pavement.
- N. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct preexcavation conference at Project site.
  - 1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
    - a. Personnel and equipment needed to make progress and avoid delays.
    - b. Utility interruptions.
    - c. Coordination of Work with utility locator service.
    - d. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
    - e. Extent of trenching by hand or with air spade.
    - f. Field quality control.

1.5 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of the following manufactured products required:
  - 1. Geotextiles.
  - 2. Controlled low-strength material, including design mixture.
  - 3. Warning tapes.
- C. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
  - 1. Classification according to ASTM D2487.
  - 2. Laboratory compaction curve according to ASTM D1557.
  - 3. Conformance with gradation limits according to ASTM C136.

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- D. If blasting is anticipated:
  - 1. Perform seismic survey and submit the survey report from the seismic survey agency.
  - 2. Submit a blasting plan to the Architect and the Owner for review and approval. Blasting plan must conform to City of Augusta and Maine Department of Environmental Protection requirements.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For qualified testing agency.
- C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

- A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
  - 1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
  - 2. Seismographic monitoring during blasting operations.
- B. Vibrations During Construction: Monitor impacts on existing structures, occupants, and vibration-sensitive equipment near the construction site to confirm vibrations from construction activities do not have deleterious impacts on them. Should vibrations from activities need to be reduced, use a combination of operating self-propelled drum rollers in static mode, smaller-sized and/or hand-operated compaction equipment, and thinner lifts to achieve compaction requirements.
- C. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
  - 1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
  - 2. Seismographic monitoring during blasting operations.
- D. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

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1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Engage a private utility location service and notify "Dig Safe System" and "OK to Dig" for area where Project is located before beginning earth-moving operations.
- C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.
- D. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.
  - 3. Foot traffic.
  - 4. Erection of sheds or structures.
  - 5. Impoundment of water.
  - 6. Excavation or other digging unless otherwise indicated.
  - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- E. Do not direct vehicle or equipment exhaust towards protection zones.
- F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

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- D. Aggregate Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, and conforming to MDOT Subsection 703.06, Type A.
- E. Aggregate Subbase Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, and conforming to MDOT, Subsection 703.06, Type D, except maximum particle size shall be 4 inches.
- F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2321, Class IB or II; except with 100 percent passing a 1-inch sieve and greater than 75 percent passing a No. 4 sieve or as indicated on drawings.
- G. Common Borrow: earth, suitable for embankment construction. It shall be free from frozen material, perishable rubbish, peat, and other unsuitable material, and conforming to MDOT Subsection 703.18, "Common Borrow."
- H. Crushed Stone/Drainage Fill/Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel, and conforming to MDOT Subsection 703.13, "Crushed Stone 3/4-inch." A nominally sized, washed 3/4-inch crushed stone usually meets this requirement.
- I. Granular Borrow: Sand and gravel of hard durable particles free from vegetable matter, lumps or balls of clay, frozen material, and other deleterious substances, and conforming to MDOT Subsection 703.19, "Granular Borrow." Granular borrow material shall not contain any particles greater than 4 inches in any dimension.
- J. Sand: ASTM C 33/C 33M; fine aggregate.
- K. Soil Filter Media: As indicated on Drawings.
- L. Structural Fill: Non-frost susceptible, well-graded sand and gravel mixture free of roots, topsoil, loam, organic material, and any other deleterious materials, as well as clods of silt or clay, and meet the following gradation requirements:

Screen or Sieve Size	Percent Passing
6 inches	100
4 inches	100
3 inches	70 to 100
No. 4	35 to 70
No. 40	5 to 35
No. 200	0 to 5

(Note: Maximum particle size shall be limited to 3 inches within 2 feet of foundation walls, footings, and floor slabs.)

- M. Underdrain Sand: Clean, free draining-sand, free from organic matter, frozen material, and conforming to MDOT subsection 703.22, "Underdrain Backfill Material," Type B.



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2.2 CONTROLLED LOW-STRENGTH MATERIAL (FLOWABLE FILL)

- A. Controlled Low-Strength Material: Self-compacting, self-leveling, low-density, flowable concrete material produced from the following:
  - 1. Portland Cement: ASTM C150/C150M, Type I or Type II.
  - 2. Fly Ash: ASTM C618, Class C or F.
  - 3. Normal-Weight Aggregate: ASTM C33/C33M, 3/8-inch nominal maximum aggregate size.
  - 4. Water: ASTM C94/C94M.
  - 5. Air-Entraining Admixture: ASTM C260/C260M.
- B. Produce conventional-weight, controlled low-strength material with 100-200 psi compressive strength when tested according to ASTM C495/C495M and 10-30 percent entrained air.

2.3 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
  - 1. Red: Electric.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone and other communications.
  - 4. Blue: Water systems.
  - 5. Green: Sewer systems.

2.4 GEOTEXTILES

- A. Subsurface Drainage Geotextile/Weed Control Barrier: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  - 1. Survivability: Class 1 for elongation >50%; AASHTO M 288.
  - 2. Grab Tensile Strength: 205 lbf; ASTM D 4632.
  - 3. Grab Tensile Elongation: 50 percent, ASTM D 4632
  - 4. Trapezoid Tear Strength: 80 lbf, ASTM D 4533
  - 5. CBR Puncture Strength: 500 lbf, ASTM D 6241
  - 6. Apparent Opening Size: No. 80 sieve, maximum, ASTM D 4751
  - 7. Permittivity: 1.4 per second, minimum, ASTM D4431
  - 8. Flow Rate: 95 gal/min/sf, ASTM D 4491
  - 9. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.

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PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

- A. Explosives:
  - 1. Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.
    - a. Perform blasting without damaging adjacent structures, property, or site improvements.
    - b. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil

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materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
  - a. 24 inches outside of concrete forms other than at footings.
  - b. 12 inches outside of concrete forms at footings.
  - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
  - d. 12 inches beneath bottom of concrete slabs-on-grade.
  - e. 9 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

### 3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
  2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
  3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
  1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
  2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

### 3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### 3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.

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- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
  - 1. Clearance: As indicated.
- C. Trench Bottoms:
  - 1. Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
    - a. Excavate trenches to subgrade elevations indicated.
- D. Trenches in Tree- and Plant-Protection Zones:
  - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
  - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
  - 3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

### 3.8 SUBGRADE INSPECTION

- A. Notify Architect and Geotechnical Engineer of Record when excavations have reached required subgrade.
- B. If Architect and Geotechnical Engineer of Record determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Identify areas where existing subgrades consist of fine-grained soils and excavate in these areas with a smooth edged bucket to avoid disturbance. Notify Architect if existing fine-grained soils are disturbed and remove disturbed material and replace with structural fill as directed.
- D. Proof-roll subgrade below the building slabs and pavements with a vibratory roller-compactor weighing at least 10 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades, or subgrades consisting of fine-grained soils classified as SM/ML, ML, MH, SM/CL, CL, or CH according to ASTM D2487.
  - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
  - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- E. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices and changes in the Work.

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- F. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, or structural fill, may be used when approved by Architect.
  - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 GEOTEXTILE FABRIC INSTALLATION

- A. Provide subsurface drainage geotextile/weed control barrier and subgrade reinforcement geotextile/separation geotextile as indicated.
- B. Install as indicated and in accordance with manufacturer's written instructions.

3.12 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
  - 2. Surveying locations of underground utilities for Record Documents.
  - 3. Testing and inspecting underground utilities.
  - 4. Removing concrete formwork.
  - 5. Removing trash and debris.
  - 6. Removing temporary shoring, bracing, and sheeting.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.

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- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- D. Backfill voids with satisfactory soil while removing shoring and bracing.
- E. Initial Backfill:
  - 1. Soil Backfill: Place and compact initial backfill of bedding, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
    - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
  - 2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing. Use only when approved by Architect.
- F. Final Backfill:
  - 1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
  - 2. Controlled Low-Strength Material (Where Indicated): Use as directed by Architect.
- G. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.14 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
  - 1. Do not scarify existing subgrades in areas consisting of fine-grained material.
- B. Place and compact fill material in layers to required elevations as follows:
  - 1. Under grass and planted areas, use common borrow soil material.
  - 2. Under walks and pavements, use granular borrow soil material.
  - 3. Under steps and ramps, use structural fill.
  - 4. Under building slabs, use crushed stone as indicated.
  - 5. Under footings and foundations, use crushed stone or structural fill as indicated on drawings.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

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3.15 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D1557:
  - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing granular subgrade and each layer of backfill or fill soil material at 95 percent.
  - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
  - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
  - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.
  - 5. For stormwater treatment areas, compact as indicated.

3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - 1. Provide a smooth transition between adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
  - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
  - 2. Waks and Pavements: Plus or minus 1/2 inch.

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- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBSURFACE DRAINAGE

- A. Subdrain Pipe: Specified in Section 334600 “Subdrainage.”

3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
  - 1. Install separation geotextile on prepared subgrade as indicated and according to manufacturer's written instructions, overlapping sides and ends.
  - 2. Place base course material over subbase course under hot-mix asphalt pavement.
  - 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
  - 4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
  - 5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  - 6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D1557.

3.20 PAVEMENT SHOULDERS

- A. Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.21 STRUCTURAL FILL

- A. Place structural fill on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrades, place and compact each layer to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D1557.

3.22 CRUSHED STONE UNDER CONCRETE SLABS-ON-GRADE

- A. Place crushed stone on subgrades free of mud, frost, snow, or ice.



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- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
  - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, crushed stone sides and ends.
  - 2. Place crushed stone 6 inches or less in compacted thickness in a single layer.
  - 3. Place crushed stone that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  - 4. Compact each layer of crushed stone to required cross sections and thicknesses to not less than 100 percent of maximum dry density determined by ASTM C29.
- C. In confined areas within four feet of foundation walls, compact with a minimum of six complete coverages with a reversible vibratory plate compactor with a minimum operating weight of 600 pounds.

3.23 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
  - 2. Determine that fill material classification and maximum lift thickness comply with requirements.
  - 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Special Subgrade Inspection: The Owner shall retain services of the Geotechnical Engineer responsible for preparing geotechnical report (RW Gillespie Inc.) to inspect footing subgrades for conformance with the geotechnical report and to observe and inspect crushed stone that will support spread footings.
- D. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- E. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- F. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:
  - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.

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2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 50 feet or less of wall length but no fewer than two tests.
  3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 50 feet or less of trench length but no fewer than two tests.
- G. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.24 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.25 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

**APPENDIX A (SUBSURFACE INVESTIGATION REPORT)**

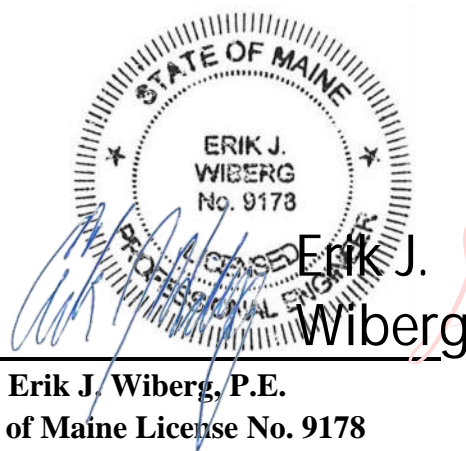
1. Included herein is a copy of the geotechnical report with respect to the building site entitled “Geotechnical Engineering Evaluation for Proposed Maine Department of Inland Fisheries & Wildlife Headquarters, Augusta, Maine.”
2. This report identifies properties of below grade conditions and offers recommendations for design of foundations and site improvements prepared primarily for use of the Architect.
3. Recommendations described are not requirements of this Contract, unless specifically referenced in Contract Documents.
4. This report, by its nature, cannot reveal all conditions existing on the site. Should subsurface conditions be found to vary substantially from this report, changes in design and construction of foundations will be made, with resulting credits or expenditures to Contract Price/Sum according to State.

# **R.W. Gillespie & Associates, Inc.**

**Report  
of  
GEOTECHNICAL ENGINEERING EVALUATION  
for  
PROPOSED MAINE DEPARTMENT OF INLAND  
FISHERIES & WILDLIFE HEADQUARTERS  
AUGUSTA, MAINE**

**Prepared  
for  
OAK POINT ASSOCIATES  
BIDDEFORD, MAINE**

**Prepared  
by  
R. W. GILLESPIE & ASSOCIATES, INC.  
BIDDEFORD, MAINE**



Digitally signed  
by Erik J. Wiberg  
Date: 2024.07.31  
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# **R.W. Gillespie & Associates, Inc.**

## **FIGURES:**

- Figure 1. Locus Map
- Figure 2. Exploration Location Plan
- Figure 3. Basement Exploration Location Plan

## **APPENDICES:**

- Appendix A. Limitations
- Appendix B. Building Additions and Storage Building Soil Boring Logs
- Appendix C. Foundation Test Pit Logs
- Appendix D. Mark Hampton Stormwater Management Test Pit Logs
- Appendix E. Logs of Previously Prepared RWG&A Subsurface Information
- Appendix F. Laboratory Test Results
- Appendix G. Recovered Rock Core Photographs

## 1.0 INTRODUCTION

### 1.01 Background

The project site is at 27 Independence Drive in Augusta, Maine, as shown in Figure 1, *Locus Map*. The project consists of structural modifications to the former CETA building, two-story additions to the north and south sides of building, a pedestrian bridge to the south addition, and a free-standing storage building. The planned additions overlay lawn areas and paved access drives. RWG&A's understanding of the site and proposed construction is based on communications with Oak Point Associates (OPA), including the following:

- Drawing No. CG101, *Grading, Drainage and Erosion Control Plan, Department of Inland Fisheries and Wildlife – New Office Headquarters Augusta*, marked *Design Development*, dated 13 March 2024.
- Architectural drawing set titled *Department of Inland Fisheries & Wildlife, New Office Headquarters, Augusta, Maine*, marked *Design Development*, dated 13 March 2024, showing the proposed floor plans for CETA building additions (note: 10 drawings).
- Architectural drawing set titled *Department of Inland Fisheries & Wildlife, Storage Barns, Augusta, Maine*, marked *Design Development*, dated 13 March 2024, showing the proposed floor plans for proposed storage building (note: 5 drawings).
- Drawing set titled *Nurses Home for the Augusta State Hospital, Augusta, Maine* prepared by Harry S. Coombs Architect, dated 27 June 1927 (note: 13 drawings).
- Drawing DF101, titled *First Floor Framing Plan*, marked *50% Submission* dated 14 June 2024 showing new column locations and shear wall within the CETA building.
- Structural reactions provided in the emails dated 26 June 2024; 2:10 PM and 03 July 2024; 8:13 AM.

Elevations used in this report were obtained from Drawing No. CG101. It's understood that elevations are in units of feet and relative to the North American Vertical Datum of 1988 (NAVD88).

### 1.02 Scope of Services

This evaluation was performed to develop site-specific soil and laboratory data, and to make geotechnical evaluations for the proposed construction, and was completed in general accordance with RWG&A's Proposal No. P-11430.GI, dated 02 August 2023 and the contract modification dated 01 May 2024. Refer to Appendix A for limitations and use of this report. As performed, RWG&A's scope of services included the following items:

1. Reviewed project information, readily available published subsurface information, geologic mapping, and visited the site to observe surface conditions.

2. Prepared a geotechnical subsurface exploration and sampling program to obtain subsurface information for use in soil and foundation evaluations.
3. Marked the exploration area for DigSafe and OK-to-DIG registered utility clearance by tape survey methods from features visible at ground surface and shown on provided plans.
4. Arranged to have the soil borings performed by a local drilling contractor as a subcontractor to RWG&A. Provided technical monitoring of exploration activities so that depths, locations, and sampling methods could be modified in response to the subsurface conditions encountered. Observed, logged, and sampled the explorations.
5. Arranged to have test pits made in stormwater management areas and against the CETA building's foundations. Arranged for a Maine-certified Soil Scientist as a subconsultant to RWG&A to observe and log stormwater management area test pits.
6. Performed laboratory tests on selected soil samples recovered from the subsurface explorations to aid in soil description and determination of engineering properties needed for foundation design.
7. Conducted engineering evaluations of the geotechnical engineering aspects of the proposed project. Emphasis was placed on foundation type, allowable foundation loads, ground floor slabs, lateral load resistance, seismic site coefficient, perimeter foundation drainage, and excavations.
8. Prepared this report presenting the findings, conclusions, and recommendations of the geotechnical evaluation.

## **2.0 SUBSURFACE EXPLORATION**

### **2.01 Project Subsurface Explorations**

The subsurface exploration program consisted of eighteen drilled soil borings, thirteen probes, and five machine-dug test pits. The subsurface exploration program is summarized below:



Exploration Type	Feature	Exploration Designations	Exploration Depth (feet)	Dates Performed
Soil Borings	South Building Addition	B-101 through B-106	5.5 to 26.1	06 December 2023
	North Building Addition	B-107 through B-110	3.7 to 12.5	
	Storage Building	B-111 through B-114	4.8 to 8.6	
	CETA Building Exterior	B-201, B-202, and B-203	11.7 to 23.5	23 May 2024
Probes	CETA Building Basement	P-1 through P-13	2.6 to 8.3	10-11 June 2024
Test Pit	Stormwater	TP-101, TP-102, and TP-103	5.2 to 10	14 December 2023
	CETA Building Foundation	TP-104 and TP-105	8 and 9	

Figure 2, *Exploration Location Plan*, shows the locations of the explorations. Proposed exploration locations were selected with OPA. RWG&A marked out the boring locations using tape or similar survey methods, using features shown on plans provided to RWG&A. Elevations in the logs were estimated using ground elevation contours shown in the plans provided. Locations and elevations should be considered accurate only to the degree implied by the methodology used to determine them.

Free water levels observed in the test borings and machine-dug test pits are indicated on the exploration logs. The observed water levels were influenced by the type of exploration and when the exploration was performed. The absence of free water data on subsurface exploration logs implies free water wasn't observed in the explorations, but it doesn't necessarily mean that groundwater doesn't occur at these locations within the vertical reach of the explorations at other times.

Building Additions, Pedestrian Bridge, and Storage Building: Soil borings and the test pits that were dug to expose building foundations were coordinated and monitored by RWG&A. A representative of OPA monitored and documented foundation conditions exposed in the test pits which Spencer Earthworks of Sabattus, Maine dug using a Yanmar Vio35 tracked excavator. Northern Test Boring of Gorham, Maine, drilled the test borings using a track-mounted drill rig.

All soil borings, except B-102A and B-104, were advanced using 2-1/4 inch inside diameter hollow-stem augers. Cased boring and rotary wash drilling methods were used at B-102A and B-104. Split-barrel sampling with standard penetration testing (*ASTM D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*) was generally performed at about 2-foot intervals in the upper 5 feet and 5-foot intervals thereafter.

Refusal surfaces were encountered in all soil borings except B-102A. Boring B-102A was drilled to obtain a thin-walled sample. The thin-walled tube sampling was performed per *ASTM D1587, Standard Practice for Thin-Walled Tube Geotechnical Sampling of Soils*. For the geotechnical

engineering evaluation, refusal was defined as 100 blows with a 140-lb. drop hammer for 1 foot or less penetration of a split-barrel sampler or an inability to advance a probe or auger with reasonable effort as determined by the driller and RWG&A representative. Rock core sampling was performed in boring B-104 using an NQ2-sized rock core barrel sampler to determine that refusal was on bedrock.

The soils encountered in the explorations were described in general accordance with *ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. Logs of the soil boring explorations are included in Appendix B. Subsurface conditions encountered in the foundation test pits are provided in Appendix C. Stratification lines shown on the exploration logs represent the estimated boundaries between the different soil types encountered and approximate refusal depths; the actual transitions will be more gradual and vary over short distances. Subsurface information should only be considered representative of subsurface conditions encountered within the vertical reach of the explorations on the date the explorations were made.

**CETA Building:** Explorations were performed near the west wall and within the basement area to help assess the thickness and composition of soils below the building. Test borings B-201, B-202, and B-203 were drilled adjacent to the west side of the CETA building by New England Boring Contractors of Hermon, Maine. The borings were drilled using a truck-mounted drilling rig and similar methods and procedures described above for the addition borings. Rock core sampling was performed in boring B-203 using an NQ2-sized rock core barrel sampler to verify that refusal was on bedrock. RWG&A observed a diagonal crack in the building's foundation wall near the building's northeast corner. See Figure 3 for the approximate location.

Probes P-1 through P-13 were performed by Bronson Drilling of Winchester, Massachusetts, within the basement to help assess the thickness and composition of the soil below. The soil borings were advanced using GeoProbe® macrocore samplers driven into the ground with a percussion, hand-guided jackhammer. The drilling subcontractor drilled the borings to depths 7 to 10 feet below the floor surface. Macrocores were collected continuously using dedicated polyethylene liners. RWG&A logged soil cores and described the subsurface materials and soils encountered.

**Stormwater Test Pits:** Three machine-excavated test pits TP-101 through TP-103 were dug by Spencer Earthworks of Sabattus, Maine, using a Yanmar Vio35 tracked excavator. Mark Hampton Associates, Inc. monitored and logged the test pits for stormwater management hydrology purposes. The test pits were advanced to depths of about 5 to 10 feet below ground surface. Mark Hampton Associates, Inc.'s *Soil Test Pit Evaluation, Proposed MDIFW Building Blossom Lane and Independence Drive Augusta, Maine*, dated 18 December 2023, is provided in Appendix D.

## **2.02 Previously Obtained Subsurface Information**

RWG&A performed explorations for OPA near the north addition area on 22 and 23 September 2022, as part of the headquarters site selection process (note: RWG&A Project No. 0767-159). Figure 2 shows the locations of the 2022 borings drilled near the planned project, and the previously prepared soil boring logs are presented in Appendix E.

### **3.0 LABORATORY TESTING**

Laboratory testing was performed to assist in describing and estimating the engineering properties of the soils. The laboratory testing program consisted of five particle-size distribution tests with natural moisture content determination and two natural moisture content determinations. Atterberg limits, hydrometer analysis, and one-dimensional consolidation tests were conducted on the recovered thin-walled sample. Two unconfined compressive strength tests were conducted on the recovered rock core sample. The tests were performed in general accordance with the following methods and procedures:

- *ASTM D1140, Standard Test Methods for Determining the Amount of Material Finer than 75- $\mu$ m (No. 200) Sieve in Soils by Washing.*
- *ASTM D6913/6913M, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.*
- *ASTM D2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.*
- *ASTM D2435/D2435M, Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading.*
- *ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.*
- *ASTM D7012, Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures, Method C.*

Moisture content test results are presented in the exploration logs. Results of other tests are presented in Appendix F, *Laboratory Test Results*. Tests were conducted at the RWG&A soil and materials testing laboratory in Biddeford, Maine.

### **4.0 SUBSURFACE CONDITIONS**

The following paragraphs summarize the subsurface conditions encountered at each school's addition. Please refer to the exploration logs in Appendices B and C for detailed descriptions of conditions encountered at specific locations.

#### **4.01 Subsurface Soils**

Building Additions and Pedestrian Bridge: Seven distinct soil units were encountered in the explorations: topsoil, asphalt, granular fill, silty sand, sandy silt, silty clay, and silty sand with gravel. Generalized soil descriptions with encountered thicknesses at soil boring locations are provided below.

<b>Deposit</b>	<b>Soil Boring Encountered Thickness (feet)</b>	<b>Description</b>
Topsoil	0.3 to 0.7	Topsoil and organic matter, moist.
Asphalt	0.25	Bituminous concrete at existing parking lot space. Encountered at B-110.
Granular Fill	1 to 5.5	Coarse to fine sand with varying amounts of silt and gravel. Encountered below topsoil fill and pavement. Not encountered at B-106 through B-109, and B-112.
Silty Sand to Silty Sand with Gravel (SM)	3 to 12.5	Moist to dry, loose to medium dense, coarse to fine sand, some silt, trace to little fine gravel. Trace roots encountered near overlying fill transition at B-104.
Sandy Silt (ML)	2.9 to 14	Dry to wet, loose to medium dense, silt with few medium to fine sand with varying amounts of clay.
Silty Clay (CL-ML)	0 to 9	Wet, medium silty clay with few sand, gray. Encountered in boring B-102, few to some silt.
Silty Sand with Gravel (SM)	1.1 to 3.5	Moist to wet, medium dense, coarse to fine sand with some silt and little gravel. Glacial till deposits.

**CETA Building:** Subsurface conditions encountered in borings B-107, B-201, B-202 B-203 drilled adjacent to the exterior of the building and probe explorations within the basement of the building are summarized below. Grades adjacent to the building are about 9 to 10 feet above the basement floor level.

<b>Deposit</b>	<b>Soil Boring Encountered Thickness (feet)</b>	<b>Description</b>
<b>Exterior Explorations</b>		
Topsoil	0.5	Topsoil and organic matter, moist. Encountered at B-107.
Asphalt	0.2 to 0.3	Bituminous concrete at access drive at west side of building.
Sandy Silt to Clayey Silt (ML to CL-ML)	8 to 15.3	Moist to wet, loose sandy silt to clayey silt with few sand, light brown to olive.
Weathered Rock	0.2 to 3.2	Weathered rock with relic rock structure.
<b>Interior Explorations</b>		
Concrete	0.3 to 0.6	Ground floor slab.
Rock Fill	0.2 to 0.5	Coarse, subrounded to angular gravel. Angularity varied with location. Pipe encountered at P-11.
Sandy Silt to Clayey Silt (ML to CL-ML)	1.7 to 7.6	Moist to wet, sandy silt to clayey silt with few sand, olive to gray.
Weathered Rock	0.1	Weathered rock. Penetration limited by drill energy and down pressure.

Storage Buildings: Below are generalized soil descriptions with encountered thicknesses at soil boring locations.

<b>Deposit</b>	<b>Encountered Thickness (feet)</b>	<b>Description</b>
Topsoil	0.3 to 0.5	Topsoil and organic matter, moist.
Granular Fill	4.3 to 4.7	Coarse to fine sand with varying amounts of silt and gravel.
Silty Sand to Silty Sand with Gravel (SM)	3.8 to 8.5	Moist to dry, loose to medium dense, coarse to fine sand, little to some silt, few to little gravel.
Silt (ML)	2.9	Dry to moist, loose, and medium to fine sand. Encountered at B-111.

#### **4.02 Groundwater**

Free water was observed about 15 to 18 feet below ground surface in the test borings B-101, B-102, and B-105 and was encountered at about 4 to 6 feet below ground surface in test pits at TP-101 through TP-103.

Free water was observed in borings B-201, B-202, and B-203 near the CETA building at depths of about 10 feet below local ground level, corresponding to about 1 foot below the basement floor level. Free water level was observed in multiple basement probes at depths 1 to 5 feet below the basement floor surface.

Water levels observed during the subsurface exploration program were influenced by the exploration methods (e.g., slow groundwater response due to low soil permeability) and are not considered representative of stabilized groundwater levels. Groundwater levels at the site will fluctuate due to season, temperature, rainfall, and construction activity; therefore, water levels during and following construction will vary from those observed in the explorations. It is likely that groundwater perches on the silty clay to silt with sand deposits seasonally and during wet climatic conditions.

#### **4.03 Bedrock**

Refusal surfaces were encountered in building addition test borings at depths ranging from about 3.7 feet to 26.1 feet below local ground surface, and refusal surface was encountered at test pit TP-103 at about 5.2 feet. Refusal surfaces were encountered about 4.8 to 8.6 feet below ground surfaces at the proposed storage building area. In general, shallower refusal surfaces were encountered in the eastern part of the site and increased in depth to the west.

Refusal surfaces were encountered in the CETA basement explorations at depths ranging from about 2.7 to 8.3 feet below the basement floor level. In general, refusal surfaces in the basement

explorations increased from east to west and were deeper in the northern part of the building than in the southern part.

The refusal surfaces encountered in the soil borings are generally interpreted to have been on bedrock but might have locally occurred on weathered rock, cobbles, or boulders. The refusal surface was verified as bedrock at borings B-104 and B-203. Recovered rock core samples were generally described as hard, slightly weathered, and slightly fractured schist. Fractures and joints were aligned with thin relict bedding planes and ranged from moderately dipping to near vertical. Bedding joints were open to tight and smooth to slightly rough. The unconfined compressive strength intact rock core sample from borings B-104 and B-203 were 15,210 and 13,370 pounds per square inch (psi), respectively. Photographs of the recovered rock cores are provided in Appendix G.

The rock quality designation (RQD) of a core sample provides an estimate of the in-place bedrock quality; see the table below developed by Deere (1968). RQD is calculated by dividing the sum of core pieces 4 inches, or greater, in length by the total length of the core run. The RQD of the cored rock at B-104 and B-203 were 70 percent and 85 percent, respectively, indicating the rock quality was fair to good. Please refer to the exploration logs for RQD values at specific locations.

RQD (%)	Bedrock Quality
90 to 100	Excellent
75 to 90	Good
50 to 75	Fair
25 to 50	Poor
0 to 25	Very Poor
Source: Engineer Manual 1110-1-2908, Engineering and Design, Rock Foundations	

## **5.0 EVALUATION OF GEOTECHNICAL DATA**

### **5.01 General**

Engineering evaluations for this project are based on the subsurface explorations, laboratory testing data, and design information available to RWG&A when this report was prepared. Should different information become known before or during construction, these evaluations should be reviewed by RWG&A to confirm their continued applicability.

### **5.02 Proposed Construction**

**Building Additions:** Planned additions consist of two-story office areas at the north and south ends of the three-story CETA building connected by three-story stair towers. The north addition will be about 50 feet by 60 feet in plan dimensions, and the L-shaped south addition will be about 145 feet by 85 feet in overall plan dimensions. The addition's ground and second floor

levels will match the existing building's floor elevations of 170.00 feet and 184.00 feet, respectively.

The north addition's first floor will be partially below grade with an at-grade entrance at the west side, and a retaining wall at the east side to provide a second-floor level at-grade entrance. The north addition uses include a mechanical room, fisheries lab, fish equipment storage on the ground floor level and heated storage, restrooms, and a storehouse on the second-floor level.

The south addition first-floor level spaces include a lobby/museum, conference room, offices, and storage areas. The second floor will include offices for the Department's commissioner and game wardens, storage rooms, conference rooms, and restrooms. The second-floor level will have an uncovered pedestrian bridge spanning about 80 feet. The west end of the bridge will be connected to the addition's structure, and the east end will bear on a free-standing abutment.

Geotechnical engineering evaluations were based on the following structural loads provided:

- Column loads:
  - Dead load: 20 to 25 kips
  - Live load: 30 to 35 kips
  - Snow load: 12 to 15 kips
- Interior continuous retaining wall footing:
  - Dead load: 2.6 kips per linear foot
  - Live load: 0.6 kips per linear foot

**CETA Building:** It's understood that the building will be renovated. A new structural framing and foundation system will be installed to support all loads except for the existing self-supported perimeter wall. In general, east-west aligned braced frames with six columns would be spaced about 16.6 to 17.2 feet in a north-south direction. Approximately 40-foot long masonry shear walls are planned along the central part of the east and west walls.

OPA estimates existing foundations bearing pressure along the perimeter wall ranges from about 3,200 to 3,800 pounds per square foot; loads will not increase above current conditions. Record drawings indicate the perimeter footing is 2 feet wide. As noted in Section 2, a diagonal crack extending from the floor to the top of the foundation wall was noticed in the building's foundation wall near the building's northeast corner. The crack indicates excessive differential and total building settlement in the crack vicinity. RWG&A recommends the building be inspected for other crack damage and repairs and modifications made as necessary.

Most columns for the new internal structural steel framing system will support only dead and live loads, each in the range of 30 to 40 kips (note: total reactions of 60 to 80 kips). Design axial seismic foundation reactions at lateral load resistance frames are  $\pm 229$  kips.

The existing footing at the new shear wall would be widened inside and outside to support the masonry shear wall reactions and the existing building wall above it. Preliminary design calls for



a total combined footing width of about 9 feet. The estimated total foundation reaction is approximately 15 kips per linear foot along the shear wall.

**Storage Building:** An approximately 95-foot by 65-foot, two-story storage building is planned northeast of the CETA building. The first-floor space will be used for unheated storage, be about one-half the size of the second-floor level, and occupy the west part of the building. The first-floor level will be at elevation 174.00 feet and daylight at the building's west side. The second-floor level will be elevation 188.00 feet and used for boat and all-terrain vehicle storage. Like the north addition, the first floor's east foundation wall and parts of the north and south walls will need to be designed as retaining walls. The first-floor elevation ranges from about 12 to 16 feet below current ground surface.

Geotechnical engineering evaluations were based on the following structural loads provided:

- Maximum exterior continuous footing:  
Dead load: 4.9 kips per linear foot  
Live load: 2.6 kips per linear foot
- Interior continuous retaining wall footing:  
Dead load: 2.6 kips per linear foot  
Live load: 1.1 kips per linear foot
- Interior column footing:  
Dead load: 45 kips  
Live load: 62 kips

RWG&A should be notified if settlement estimates provided in this report exceed tolerable amounts as determined by the designers.

### **5.03 Foundation and Ground Floor Slab**

#### **5.03.01 Building Additions and Storage Building**

With proper site preparation, the proposed additions, storage building, and pedestrian bridge may be supported by shallow foundations consisting of spread and/or continuous footings with slab-on-grade floors, all bearing on naturally deposited inorganic soil or newly compacted structural fill. Perimeter foundation drainage should be provided. Due to differences in subgrade modulus and the potential for excessive differential settlement and crack damage, foundations should be supported entirely on soil and not a combination of the soil and bedrock. Total settlement and angular distortions of less than 1 inch and 1/350, respectively, should be anticipated for relatively uniformly loaded foundations. Differential settlements of about ½ inch should be expected near the existing building/addition interface and about ¼ to ½ inch of settlement in the existing building wall where new footings abut or are within the influence of new footings.

The north addition design will need to resist unbalanced earth pressure forces between the opposite buried and exposed foundation walls of the daylighted first floor level. Unbalanced



earth pressures due to daylighted areas are typically resisted in one of two ways. One method is to design the buried foundation wall as a retaining wall based on at-rest lateral earth pressures. A second method is to provide structural connections to convey the unbalanced lateral earth pressure forces to interior column and/or wall footings where they are resisted by bottom friction and earth pressure acting on the interior footings. Regardless of the method, the construction documents should specify that the buried foundation wall be backfilled last.

### **5.03.02 CETA Building**

Based on communications with OPA, it's understood that soil-supported foundations to support the internal framing system at soil bearing pressures needed to reduce estimated differential settlements to tolerable amounts are impracticable due to their size. New foundations should develop load resisting in or on bedrock to limit differential movement. New spread footing foundations bearing on bedrock at all locations is impracticable due to the depths of the excavations that would be needed and their proximity to the existing building's foundation walls. Rock-socketed micropiles are recommended where spread footings bearing on bedrock are impracticable.

RWG&A estimates settlement of the combined shear wall will be in the range of  $\frac{1}{4}$  to  $\frac{1}{2}$  inches and will induce movement of the existing building's wall. Some crack damage/development should be anticipated in the existing masonry brick wall as foundation and soil stresses are redistributed along the foundation as service loads are realized.

### **5.04 Slope Retaining Features**

An approximately 63-foot-long cast-in-place concrete site retaining wall with an exposed height of about 12 feet will extend from the northeast corner of the north addition to the southwest corner of the storage building. An approximately 98-foot long retaining wall with an exposed height of about 4 feet is planned south-southeast of the proposed storage building; the wall-type will be either cast-in-place concrete or modular block wall. Soil conditions are considered suitable for using both wall types. The retaining walls should be structurally isolated from the buildings.

Runoff from behind the retaining wall should be diverted away from and around the retaining wall to reduce the potential for flow over the walls and infiltration into the reinforced fill and retained soils. Geotextile soil reinforcement with lengths of about 65 to 80 percent of the wall height is generally required for internal stability of segmental block walls retaining flat backfill; soil reinforcement lengths about the same as the wall height are generally needed for stability of segmental block walls.

It is anticipated that design of the retaining wall system, including internal and global stability evaluations, will occur during final design. The project's design Geotechnical Engineer of Record should be provided the opportunity to review the geotechnical aspects of retaining wall design and shop drawings before construction. It is recommended that a minimum factor of safety of 1.5 for global stability of retaining walls be used.

### **5.05 Construction Considerations**

Site Preparation: Fill was encountered in explorations in each of the building addition areas and the proposed storage building areas. Preparation of the site before placement of the fill, the composition of the fill, and the methods used to place and compact the fill are uncertain. The fill is considered undocumented and unsuitable to support ground floor slabs and foundations. For planning and budgeting purposes, it should be anticipated that fill will need to be removed down to naturally deposited inorganic soil and replaced with compacted structural fill.

Rock Excavation: Refusal surfaces were encountered at or above the anticipated design bottom of exterior footing levels and/or finish ground floor levels at the additions and storage building. Refusal surfaces were shallowest at the borings drilled in the east part of the additions. Refusal surfaces were encountered about 4.8 to 8.6 feet below current ground surface in the storage building borings (note: B-111 through B-114), which was about 4 to 8.2 feet above the first floor level at the building's west side and near anticipated bottom of exterior footing level at the storage building's east side. It should be anticipated that blasting will be needed to fragment and excavate bedrock. Rock excavation can likely be accomplished with mechanical methods (e.g., bulldozer or hydraulic excavator with rippers, jackhammers, and hydraulic hammers) for relatively small quantities.

Vibrations During Construction: Vibrations from construction activities might have deleterious effects on existing structures, occupants, and vibration-sensitive equipment. Where self-propelled drum rollers are used for fill compaction, they might need to be operated in static mode. If compaction requirements cannot be met with this approach, then smaller-sized and/or hand-operated compaction equipment and thinner fill lifts could be used to achieve compaction requirements while reducing construction vibrations.

Construction Dewatering: The on-site naturally deposited soils at proposed building additions and storage building areas are sensitive to disturbance when wet. To reduce disturbance of exposed subgrade soils, it will be important to divert runoff, provide positive grading to shed seepage and runoff from flat areas, and compact exposed soils to reduce rutting, ponding, and surface water infiltration. RWG&A anticipates that if groundwater is encountered during construction, then groundwater control can be accomplished through the use of ditches, sumps, and open pumping.

Use of On-site Soils: It is anticipated the surficial topsoil will be stripped and be either incorporated into proposed landscaped areas, where practicable, or hauled off-site. Topsoil and organic materials are not considered suitable for use as common fill. The subsurface soils from foundation and site work excavations will generally consist of topsoil, fill, silty sand to silty sand with gravel, and silt.

Visual-manual descriptions and laboratory tests indicate the fill and naturally deposited soils are unsuitable for use as compacted structural fill beneath the proposed additions or as backfill around foundations. With proper moisture conditioning and earthwork handling, existing fill might be able to be used as common fill in landscaped areas. If on-site soils are proposed for use other than common fill, the soil should be stockpiled separately and tested to determine if it meets specification requirements for its intended use.

## **6.0 RECOMMENDATIONS**

The recommendations presented below are provided for use in design and construction of the building additions and free-standing storage building. Subsurface conditions at the project site will greatly influence foundation design and site work construction. RWG&A recommends foundation design and construction comply with the requirements of all applicable ordinances, regulations, and rules. When this report was prepared, the applicable building code in Augusta, Maine, was the Maine Uniform Building and Energy Code, which adopts *2018 International Building Code*® by reference.

### **6.01 Site Preparation**

1. All topsoil, fill, organic material, debris, rubbish, frozen soils, muck, loose, or disturbed soils and other unsuitable materials, including asphaltic pavement, should be removed from proposed construction areas. Unsuitable materials include uncontrolled fills (i.e., fills placed without systematic densification and moisture control to acceptable percent compaction) and deleterious substances. Backfill in test pits made for this project should be removed and replaced with suitable compacted fill.
2. Due to the previously developed nature of the site, the Project Contractor and their Subcontractors should be sensitive to the potential of encountering obstructions, such as remnants from prior structures and buildings, associated foundations, and underground utilities (note: both active and abandoned) during site and earthwork activities. It is anticipated that obstructions may include, but are not limited to, pipes, concrete footings, masonry blocks, rubble, dry wells, and buried utilities. Where such items are encountered beneath the proposed building limits, they should be excavated to their full extent, removed, and replaced with compacted structural fill. The ends of underground pipes and utility conduits outside the proposed building footprints that will be abandoned in place should be filled with concrete and capped to prevent erosion of material into the conduit or pipe.
3. Existing fill below ground floor slab areas and within 5 feet outside of addition limits should be removed and replaced with compacted structural fill. Excavated fill proposed for reuse should be stockpiled and tested for conformance with its intended use.
4. Surface grading should provide positive drainage away from constructed facilities both during and after construction. Dewatering requirements will vary across the site based on groundwater levels encountered during construction and soil types. In general, it should be practical to accomplish construction dewatering from within excavations using open pumping methods to a depth of one to two feet below groundwater surface. Surface runoff and groundwater infiltration should be controlled so excavation, filling, and foundation construction can be completed in-the-dry.
5. Excavations adjacent to the buildings and utilities to remain should be designed to limit movements of the existing structures to tolerable amounts as determined by the Structural Engineer and Civil Engineer. The Contractor's excavation procedures and shoring and

lateral support design, including lateral support for new construction, should be submitted for review by the Structural Engineer before construction.

## **6.02 Rock Excavation**

6. Bedrock excavation will require systematic drilling and blasting to fragment and loosen rock. Relatively small quantities of bedrock might be able to be removed with mechanical methods (e.g., jackhammers, and hydraulic hammers).
7. Bedrock excavation should only be performed by contractors with demonstrated successful experience in projects of similar scope. Pre-blast condition surveys will need to be conducted on all structures on nearby properties in accordance with federal, state, and local rules and regulations in anticipated blasting areas. Emphasis should be placed on nearby, vibration-sensitive structures such as swimming pools, plaster-walled buildings, machinery, equipment, wells, and utilities.

Technical specifications should require blasting vibrations to be in accordance with U.S. Bureau of Mines R18507-80, Table B-1 and City of Augusta ordinances. In addition, specifications for work should require matting or earth cover for protection against uncontrolled flyrock and no limit peak air concussion to less than 129, 126, and 124 decibels for 1, 2, and 3 blasts per day, respectively, as measured at the location of the nearest structure, facility, or roadway, considering wind direction.

8. Bedrock excavation should only be performed by contractors with demonstrated successful experience in projects of similar scope. Over-blasting rock should be avoided. Blast rounds should be designed to limit ground vibrations and airblast overpressures per federal, state, and local rules and regulations.
9. Monitoring should be undertaken during blasting activities to confirm and document that the above criteria are complied with. Seismograph monitoring points might change as the work progresses. Monitoring points should consider distance from a blast round to the closest structures and type of structure and condition. Monitoring points for airblast overpressures should consider wind direction and weather conditions.

Initial test shots of small blast charges should be designed, monitored, and conducted in the area of rock removal before production blasting to determine site-specific blasting characteristics. A relationship using charge weight distance versus vibration and air blast overpressures should be developed based on the initial test shots and subsequent production blasting rounds, and be used to guide blasting activities.

10. Where footing will otherwise bear on a combination of soil and compacted fill and bedrock, bedrock removal should extend to a minimum of 1 foot below bottom of footing and 6 inches below ground floor slab levels to allow placement of a compacted structural fill cushion between the bottom of footing or slab and bedrock. All loose, dislodged, fragmented, decomposed, highly weathered, and unsound rock, including rock overbreak, should be removed before fill placement.

**6.03 Site Filling**

11. Only structural fill should be used as fill below foundations, ground floor slabs, and as backfill within 2 feet of footings, piers, and foundation walls. Structural fill should be a well-graded sand and gravel mixture free of roots, topsoil, loam, organic material, and any other deleterious materials, as well as clods of silt or clay, and meet the following gradation requirements:

Screen or Sieve Size	Percent Passing
6 inches	100
3 inches	70 – 100
No. 4	35 – 70
No. 40	5 – 35
No. 200	0 – 5

(Note: Maximum particle size should be limited to 3 inches within 2 feet of foundation walls, footings, and floor slabs.)

12. In open areas, structural fill should be placed in level, uniform lifts not exceeding 12 inches in uncompacted thickness and be compacted with self-propelled compaction equipment. In confined areas and within 4 feet of foundation walls, structural fill should be placed in lifts not exceeding 6 inches in uncompacted thickness and be compacted with hand-operated compaction equipment. All fill placed for footing and slab support should be structural fill compacted to at least 95 percent of the maximum dry density as determined by *ASTM Standard D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort* (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
13. Large compaction equipment may cause perceptible shaking inside and near existing buildings. This is due, in part, to the proximity of proposed construction to the existing buildings. The shaking might disturb occupants inside the building and cause items hanging on the walls to fall and windows to crack. Methods of reducing these vibrations include using smaller compaction equipment and compacting with vibratory energy at low settings or statically, if necessary. Compacting with low vibratory energy or statically will probably require use of thinner fill lifts and more passes/coverages with the equipment to achieve the necessary density.

**6.04 Foundations****6.04.01 General**

14. The building additions should be designed to withstand lateral, uplift, and overturning forces due to earthquakes. The in-place soils encountered in the explorations are not considered susceptible to liquefaction. In accordance with the *2018 International*

*Building Code*<sup>®</sup>, the building addition sites are classified as Site Class D, and the storage building site is classified as Site Class C.

#### **6.04.02 Spread Footing Foundations**

15. The proposed additions, storage building, and pedestrian bridge may be supported on spread and/or continuous footings bearing on the inorganic naturally deposited soils or compacted structural fill. New foundations within the CETA building may be supported on spread and/or continuous footings bearing on prepared bedrock subgrades, except that the widened masonry shear wall footing may bear inorganic naturally deposited soils or compacted structural fill. The footings should be proportioned for the following allowable contact pressure:

<b>Proposed Construction</b>	<b>Allowable Contact Pressure (pounds per square foot)</b>	<b>Anticipated Approximate Settlement Amounts</b>
South Addition	1,500	Total settlement of 1 inch. Differential at existing/addition interface: ¼ to ½ inch. Angular Distortion: <1/350.
North Addition Pedestrian Bridge	1,500	Total settlement less than 1 inch. Differential at existing/addition interface: ¼ to ½ inch. Angular Distortion: < 1/350.
Storage Building	5,000 for Bearing Only on Bedrock or Concrete on Bedrock  2,000 for Compacted Structural Fill and/or Naturally Deposited Soil	Total settlement less than 1/2-inch.
CETA Building	5,000 for Bedrock or Concrete on Bedrock Bearing Only  Masonry Shear Wall: 1,500 psf	Total settlement less than 1/4-inch.  Total settlement less than 1/2-inch.

16. Minimum footing width should be following concrete design and building code requirements, and no less than 2 feet. For footings having a least lateral dimension less than 3 feet, the above allowable pressure should be taken as 1/3 of the above value times the least dimension in feet
17. A 1-foot thick overexcavation and replacement with compacted structural fill or 3/4-inch crushed stone is recommended for footings located on or below fine-grained naturally deposited soils (note: silty clay, clayey silt, and silt) to protect naturally deposited soil subgrade from excessive disturbance during construction. Crushed stone should be separated from adjacent soil with a geotextile fabric (Mirafi 160N or equivalent). Crushed stone or structural fill should extend one foot outside the limits of the foundation.

Crushed stone should meet the requirements of *State of Maine Department of Transportation (MaineDOT) Standard Specifications November 2014 Edition Section 703 – Aggregates, 703.13 Crushed Stone ¾-Inch*. Particle-size distribution of crushed



stone shall be tested for compliance with MaineDOT requirements by *ASTM Designation: C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate*. In confined areas, within 4 feet of foundation walls, crushed stone should be placed in lifts not exceeding 6 inches in loose lift thickness and be compacted with a minimum of six complete coverages with a reversible vibratory plate compactor with an operating weight of 600 pounds, minimum. Special Inspections for the project should include full-time observation of placement and compaction of crushed stone that will support spread footings.

18. Where the structure would otherwise be partially supported on soil and bedrock, the bedrock should be removed to a minimum depth of 12 inches below design bottom of foundation and replaced with compacted structural fill (i.e., no direct bearing on bedrock). Preparation of bedrock subgrades before placing structural fill should include removal of all loose, fragmented, decomposed, highly weathered, and unsound rock.

If the foundation is designed to be supported on only bedrock, soil should be removed to provide all rock bearing. Rock-bearing subgrades should be pitched no steeper than 4H:1V). Preparation of bedrock subgrades below foundations should include removal of all loose, fragmented, decomposed, highly weathered, and unsound rock. The bedrock subgrade should be washed with high-pressure air before placing concrete. A concrete leveling pad placed directly on prepared bedrock may be used to provide a uniform surface for the placement of footings. Minimum recommended compressive strength of leveling pad concrete is 2,000 pounds per square inch.

19. As a precaution against undermining the existing building's foundations, footings for the additions should be located above an imaginary line projecting at a pitch of 1.5H:1V down and away from the outside edge of existing footings. The need for lateral support and bracing of existing foundations should be evaluated if new footings will be located below the line.
20. Excavation of footing and ground floor slab-bearing surfaces in soil or fill should be performed by earthwork equipment fitted with smooth-edged buckets. Final subgrade preparation should include compaction of fill or naturally deposited soil subgrades with hand-guided, vibratory compaction equipment. Following compaction and before concrete placement, care should be taken to limit disturbance of the bearing surfaces. Any loose, softened, or disturbed material due to construction traffic should be removed before concrete placement and backfilled with compacted structural fill.
21. It is recommended that design bottom of footing level for exterior building footings bearing on structural fill or naturally deposited soil be a minimum of 5 feet below lowest adjacent ground surface exposed to freezing temperatures. The bottom of the pedestrian bridge abutment footing bearing on structural fill or naturally deposited soil be a minimum of 6 feet below lowest adjacent ground surface exposed to freezing temperatures. At heated interior locations, footings may be designed to bear a minimum of 2 feet below top of ground floor slab. If exposure to freezing temperatures is anticipated, either during or following construction, then interior footings should be lowered in accordance with the recommendations for exterior footings.

22. The integrity of natural soils and structural fill must be maintained during cold weather conditions. Footing and slab subgrades should not be allowed to freeze. The naturally deposited soils are considered highly frost-susceptible. Freezing of subgrade soils beneath footings and floor slabs may result in heaving and post-construction settlement. The Contractor should make every effort to prevent freezing of subgrade soils. In the event frost penetration occurs, all frozen and previously frozen soils should be removed and replaced with compacted structural fill. At no time should frozen material be placed as fill.
23. Lateral loads from wind and earthquake may be resisted by friction between the foundation bottoms and supporting foundation-bearing material, and earth pressure against the sides of foundations. The following lateral bearing pressure and sliding resistance are recommended for anticipated foundation bearing materials:

Foundation Bearing Material	Lateral Bearing Pressure (pounds per square foot per foot below finished grade)	Coefficient of Friction	Cohesion (pound per square foot)
Compacted Structural Fill Compacted Crushed Stone Naturally Deposited Silty Sand with Gravel	200	0.35	--
Naturally Deposited Silt	100	0.25	---

#### **6.04.03 Micropiles**

24. Micropiles should be used for new CETA building foundations where spread footings bearing on bedrock is impracticable and as an alternative to spread footing foundations. The recommendations included below are suitable for design of micropiles in compression and tension.
25. Micropiles should be designed, installed, and tested by a pre-qualified specialty contractor with demonstrated experience in constructing and testing micropiles in similar environments, subsurface, and bedrock conditions. The micropile design should be determined by a qualified professional engineer licensed in the State of Maine and engaged by the specialty contractor. Micropiles are recommended to resist both uplift and compression loads.
26. Contract documents should address micropile cost, schedule, and coordination considerations if subsurface obstructions to micropile installation are encountered during construction, including required micropile abandonment, relocation, reanalysis, redesign, and detailing.
27. Micropile design should be coordinated with the foundation designer(s). The recommended minimum factor of safety for geotechnical resistance to compressive axial and uplift loads is 3. A design/build performance-based specification for micropile design



and installation is recommended to allow for alternate specialty contractor(s) methods and experience.

28. Micropiles should be designed to develop 100 percent of their load-carrying capacity in side resistance below top of bedrock. An ultimate rock/grout bond stress of 180 psi with a minimum factor of safety of 2.5 is recommended for use in design. The ultimate bond stress is based on grout having a minimum unconfined compressive strength of 4,000 psi.
29. Where proposed micropile locations conflict with obstructions that cannot be penetrated during drilling or with underground utilities that will not be removed, micropiles should be offset by a minimum of 1 pile diameter and additional pile provided as needed. Construction documents should address requirements for relocating and/or adding micropiles if obstructions are encountered during construction. The need for modifications to pile caps and grade beam design due to relocation of micropiles should be anticipated.
30. For planning purposes, a micropile lateral capacity of 1 ton per pile can be used to design building foundations. The micropile designer should verify lateral capacity after the micropile dimensions are determined. Battered piles can be used to achieve higher lateral capacities.
31. Micropile boreholes should be advanced using methods that minimize the loss of ground beyond the design micropile diameter and protects existing structures and new construction from disturbance. Grouting of each micropile should be completed in one continuous operation. Grout should be pumped through a tremie tube from the bottom of the micropile borehole upward. The bottom of the tremie tube should be located within 1 foot of the borehole bottom.
32. A verification load test should be conducted on a minimum of one micropile in compression and tension before production pile installation to confirm that the selected bond length for the pile and the Contractor's installation equipment, methods, and procedures that will be used in production pile installation are capable of producing the required grout-to-rock bond nominal strength. If ground and/or installation procedures change, then additional testing might be needed.

The verification load test should be conducted following *ASTM D1143/D1143 M-07, Standard Test Methods for Deep Foundations Under Static Axial Compressive Load, Procedure A (Quick Test)* for compression loads and *ASTM D3689/D3689M-22 Standard Test Methods for Deep Foundation Elements Under Static Axial Tensile Load* for tension loads. The maximum verification test load should not be less than two times the design axial compressive load. The structural design of the verification load test pile should consider test load conditions.

Verification test pile may be used as a production pile provided that the following conditions are met:

- the pile is designed with a structural factor of safety of at least 1.25 at maximum test load,

- the pile is not failed or overloaded during testing, and
  - the pile can be replaced if the pile fails.
33. Proof load tests should be conducted on a minimum of five percent of production *micropiles* to evaluate the ability of production micropiles to safely withstand in-service design loads. Proof load tests should be conducted per *ASTM D1143/D1143 M-07, Standard Test Methods for Deep Foundations Under Static Axial Compressive Load, Procedure A (Quick Test) for compression loads* and *ASTM D3689/D3689M-22 Standard Test Methods for Deep Foundation Elements Under Static Axial Tensile Load* for tension loads. The maximum proof test load should not be less than 1.67 times the design axial load.
34. Technical specifications should require the Contractor to submit information on the proposed micropile construction systems, including quality control and testing methods and methods for probing for and passing through obstructions for review by the project Structural Engineer and RWG&A before equipment mobilization.

#### **6.05 Concrete Retaining Walls**

35. Foundation walls with unbalanced earth pressures acting upon them that cannot be allowed to move or are otherwise restrained should be designed to withstand an at-rest equivalent fluid unit weight of 65 pounds per cubic foot ( $K_o = 0.5$ ). Lateral load from surcharges such as book storage racks can be accounted for by applying a uniform vertical pressure (e.g., 150 pounds per square foot) multiplied by the at-rest earth pressure coefficient. The above equivalent fluid unit weights assume that the walls are backfilled with structural fill and provisions are made to prevent the rise of groundwater above water above the bottom of wall level. It is recommended that retaining walls be designed with a resultant load within the middle third of the footing and a maximum contact pressure at the toe that is not greater than the recommended allowable bearing pressure in Recommendation 15 above.
36. The above equivalent fluid unit weights assume provisions are made to prevent the rise of water above the bottom of wall (i.e., footing drains) and that the walls are backfilled with structural fill.
37. It is recommended that foundation walls be designed with the resultant load within the middle third of the footing and that a maximum contact pressure at the toe of wall be no greater than the maximum allowable bearing pressures for the building provided above. The Structural Engineer should consider construction loading conditions on basement foundation walls to check if floor slab and/or other restraints against foundation walls are needed before backfilling.
38. Earthquake forces against building foundation walls with unbalanced earth pressures against them should be calculated using the following formula:

$F_w = 0.1(S_s)(F_a)(\gamma_t)(H^2)$  where

$S_s$  = maximum considered earthquake spectral response acceleration from the IBC 2015,

$F_a$  = site coefficient from the IBC 2018,

$\gamma_t$  = total unit weight of the soil = 135 pounds per cubic foot, and

$H$  = height of the wall measured as the difference in elevation of finished ground surface or floor in front of and behind the wall.

The earthquake force should be distributed as an inverted triangle over the height of the foundation wall.

## **6.06 Foundation Drainage**

39. Perimeter footing drains should be installed at the perimeter of the additions. The drains should be installed at the exterior bottom of footing level or at least 18 inches below the adjacent finished floor level, whichever is lower. The drains should consist of perforated pipe bedded in 2 cubic feet of underdrain stone per linear foot. Underdrain stone should consist of *MaineDOT, Standard Specifications Revision of December 2014, 703.22 Underdrain Backfill Material Type C*. The underdrain stone should be encapsulated in a filter fabric.
40. Flow from the foundation drains should be conveyed by gravity to a surface drainage feature or storm drain that will be free-flowing at all times and under all conditions. Existing foundation drains should not convey flow from the new foundation drains without verifying that existing foundation drains will meet recommended drainage criteria for new foundation drains.

Multiple outlets should be provided so as not to be dependent on a single flow path. Surface water drainage features, including roof drains, pipes, catch basins, manholes, drip edges, and infiltration trenches and basins, should direct water away from foundation drainage at all times and locations. Existing and new roof drains should not be connected to the foundation drains.

## **6.07 Ground Floor Slabs**

41. Interior floors may be slab-on-grade construction based on a subgrade modulus of 150 pounds per cubic inch. The slab should be underlain by a minimum of 12 inches of compacted structural fill. A vapor retarder should be provided below the ground floor slab to reduce moisture infiltration. Concrete slab-on-grade floors, regardless of their design or construction, are prone to some cracking and the use of control joints and concrete reinforcing are methods to reduce random patterned cracking. It is anticipated design and construction details of the floor slab, including concrete thickness,

reinforcing, bedding, control joint depth and spacing, and the vapor retarder type and thickness, will be provided by the project Structural Engineer.

42. A crushed stone drainage blanket with a collection/outlet pipe is recommended beneath the CETA building floor slab. The drainage blanket should be at least 6 inches thick and constructed with underdrain stone. Underdrain stone should consist of MaineDOT, Standard Specifications Revision of December 2014, 703.22 Underdrain Backfill Material Type C. The pipe should be 4-inch diameter, perforated, and rigid, and it should be placed in a shallow trench with the pipe invert 6 inches below the subgrade outside the trench. Filter fabric should be placed over the subgrade below the drainage stone. Utility design will need to be coordinated with the underslab drainage to not mix the crushed stone with other fill materials or damage the drain pipes and filter fabric. Provisions for underslab drainage should be provided as recommended above for foundation drainage.
43. Exterior slabs at entrances and other locations sensitive to frost action should be underlain by a minimum of 5 feet of underdrain stone. The underdrain stone should be completely wrapped in a filter fabric to prevent the migration of surrounding soils into the stone. Slabs at locations where frost heaving is tolerable should be underlain by a minimum of 24 inches of structural fill. The surrounding area should be pitched to drain away to reduce available moisture for ice and frost lens generation.

#### **6.08 Cast-in-Place Concrete Site Retaining Walls**

44. Structural fill should be used as backfill behind retaining walls. Only vibratory plate compactors and/or walk-behind rollers should be used to compact backfill within 100 percent of the retaining wall height.
45. Site retaining walls that are able to move may be designed for active earth pressure conditions. Site walls with level backfill should be designed to withstand an active equivalent fluid unit weight of 45 pounds per cubic foot ( $K_a = 0.33$ ). The site wall south-southeast of the storage building, with ascending slope pitched at 3.7H:1V behind it, should be designed to withstand an active equivalent fluid unit weight of 75 pounds per cubic foot ( $K_a = 0.55$ ). Lateral load from vehicle surcharge can be accounted for by applying a uniform vertical pressure equal to 250 pounds per square foot multiplied by the active earth pressure coefficient.

Site retaining walls with level backfill behind them and unable to rotate may be designed for at-rest conditions using an equivalent fluid unit weight of 68 pounds per cubic foot ( $K_o = 0.5$ ). The site wall south-southeast of the storage building, if unable to rotate, should be designed using an equivalent fluid unit weight of 115 pounds per cubic foot ( $K_o' = 0.85$ ). Lateral load from vehicle surcharge can be accounted for by applying a uniform vertical pressure equal to 250 pounds per square foot multiplied by the at-rest earth pressure coefficient.

Sliding of retaining walls bearing on soil can be resisted by friction along the bottom of the wall footings based on a friction coefficient of 0.35. Passive forces acting upon the front of the wall may also be utilized to resist sliding, provided both sides of the wall are

backfilled simultaneously. A passive equivalent fluid unit weight of 200 pounds per square foot per foot below finished grade may be used.

The above equivalent fluid unit weights assume provisions are made to prevent the rise of water above the bottom of wall (i.e., footing drains) and that the walls are backfilled with structural fill. It is also recommended that drains should be provided to prevent the rise of water table above the wall bottom for global stability, retaining walls be designed with the resultant load within the middle third of the footing, and that a maximum contact pressure at the toe of wall be no greater than the maximum allowable bearing pressures for the building provided above in paragraph 6.04 Foundations.

### **6.09 Prefabricated Modular Block Retaining Walls**

46. The modular block retaining wall south-southeast of the storage building should be designed by a qualified Maine-licensed Professional Engineer. RWG&A requests the opportunity to review the geotechnical aspects of the retaining walls design and shop drawings before construction to confirm the recommendations herein are interpreted as intended.
47. Existing fill beneath the retaining wall and reinforced zone should be removed down to naturally deposited inorganic soil and replaced with granular borrow compacted to a minimum of 95% of the soils maximum dry density as determined by ASTM D1557.
48. Stormwater, sewer, and other liquid-carrying pipes should be located outside of geotextile-reinforced zones. Foundations supporting structures such as light poles and guide rails located near retaining walls should be coordinated with retaining wall design. Foundation support structures should be located entirely below a line pitched at 1H:1V projecting up and away at the back of wall footings, modular block wall units, and behind reinforced zones.
49. Recommended soil parameters for use in design of modular block retaining walls at the site are listed below. It is also recommended the designer review these recommendations for compliance with the project-specific block and geogrid manufacturer recommendations.

#### Existing Foundation and Retained Soils

##### Structural Fill

Unit Weight = 130 pounds per cubic foot

Friction Angle = 32 degrees

Cohesion = 0 pounds per square foot

Ka = 0.3 for level retained fills

Allowable Bearing Pressure = 2,000 pounds per square foot

##### Wall Backfill

Free-draining cohesionless soil – composition determined by designers

Cohesion less than 25 pounds square foot

Friction Angle = 36 degrees verified per *ASTM D3080, Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions*

Equipment/Pedestrian Surcharge

Live Load = 250 pounds per square foot

Factor of Safety

Geogrid Pullout = 1.5

Construction Uncertainties = 1.5

Overturning = 2.0

Global Stability = 1.3 with groundwater at exposed ground surface or 2 feet above transition from in-situ fill to naturally deposited soil, whichever is lower.

50. Only sand and gravel having less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve size should be used as backfill within 5 feet horizontally from the back of the segmental block wall unit.
51. The wall designer should perform an evaluation of global stability of the wall and slope. The evaluation should verify that the minimum recommended factor of safety exceeds 1.5.
52. Manufacturer's certifications and laboratory test results should be submitted by the contractor to verify the above criteria are complied with. The friction between geotextile reinforcing and backfill will depend upon the geotextile and fill materials selected by the contractor. In turn, the wall submittal should demonstrate that the friction between the fill and geotextile exceeds the resistance needed.
53. A minimum reinforcement length of 70 percent of the wall height should be provided where needed for internal or external stability. Greater lengths might be needed for global stability. Reinforcement length should be the same from the bottom to the top of the wall section.
54. The contribution of resistance to passive earth pressures at the toe of retaining walls should be ignored in stability evaluations.
55. Drains should be provided to prevent hydrostatic pressure buildup behind modular block walls. The drains should be located at the base of the retaining wall and the uphill limit of the reinforced backfill zone. Drains should outlet by gravity to a surface drainage feature or storm drain that will be free-flowing at all times and under all conditions.

**6.10 Temporary Excavations**

56. Soils encountered at building addition sites consisted of topsoil or asphalt/ fill, silty sand to silty sand with gravel, silt with varying sand, and clayey to silty clay. Soils encountered at the storage building site consisted of topsoil or asphalt/ fill, silty sand to silty sand with gravel, and silt with varying sand. We anticipate that foundation and utility excavations can be accomplished using sloped, open-cut techniques. It is also anticipated that dewatering can be accomplished using sumps and open pumping methods.



The Contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

As a safety measure, it is recommended all vehicles and spoil piles be kept a minimum lateral distance from the top of excavations equal to no less than 100 percent of the slope height. Exposed slope faces should be protected against the elements.

### **6.11 Geotechnical Observation**

The geotechnical recommendations provided as the basis for design of this project were developed using a limited number of observations and tests. The Owner should be sensitive to the potential need for adjustment in the field. We recommend that the Owner retain RWG&A to observe geotechnical construction aspects of the project. These services should include observing general compliance with the design concepts, specifications and recommendations, and assisting in development of design changes should subsurface conditions differ from those anticipated before the start of construction. Observation improves the likelihood that the design intent will be carried out during construction. In addition, it allows RWG&A to confirm its design recommendations. For this project, geotechnical observation of the following aspects is recommended:

- Site stripping
- Removal of unsuitable fills
- Structural fill placement and compaction
- Preparation of foundation subgrades

In addition to geotechnical observation, RWG&A can also provide full-service construction inspection and materials testing. This would include soils, portland cement and asphaltic concrete, structural steel and welding inspections, destructive and non-destructive testing, and special inspection services in fulfillment of building code requirements.

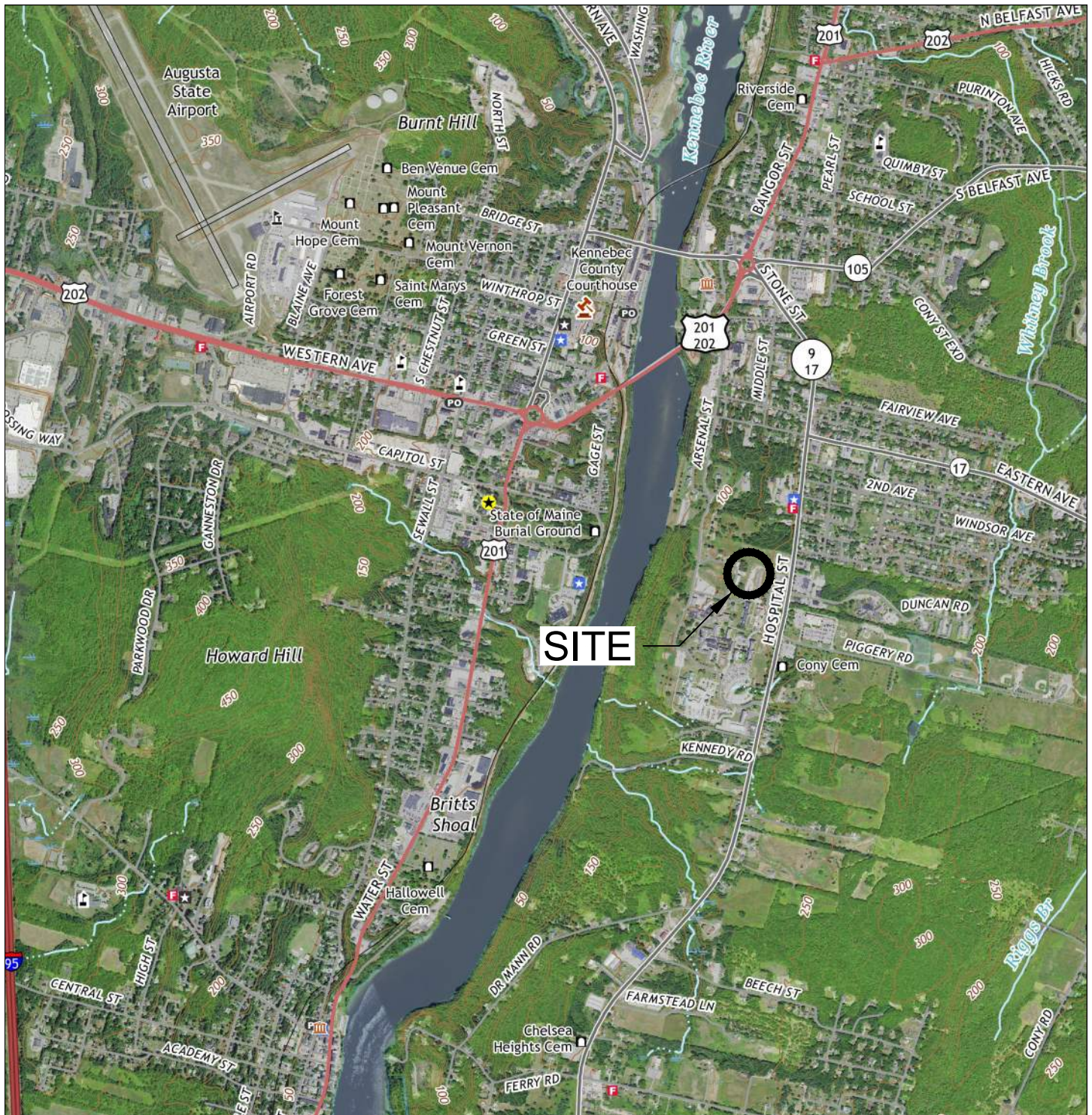
## **7.0 CLOSURE**

This report has been prepared for specific application to planned additions to the CETA building and the construction of a new storage building at 27 Independence Drive in Augusta, Maine, for the exclusive use of Oak Point Associates. This work has been completed in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. If any changes are made in the nature, design, or location of the proposed

construction, the conclusions and recommendations of this report should be reviewed by RWG&A.

The recommendations presented are based on the results of widely spaced explorations. The nature of variations between the explorations may not become evident until construction has begun. If variations are encountered, it will be necessary for RWG&A to re-evaluate the recommendations presented in this report. RWG&A requests an opportunity for a general review of the final design and specifications to determine that earthwork and foundation recommendations have been interpreted in the manner in which they were intended.





SCALE, FEET

SOURCE:  
USGS 7.5-MINUTE TOPOGRAPHIC QUADRANGLE OF  
AUGUSTA, ME, DATED 2021.

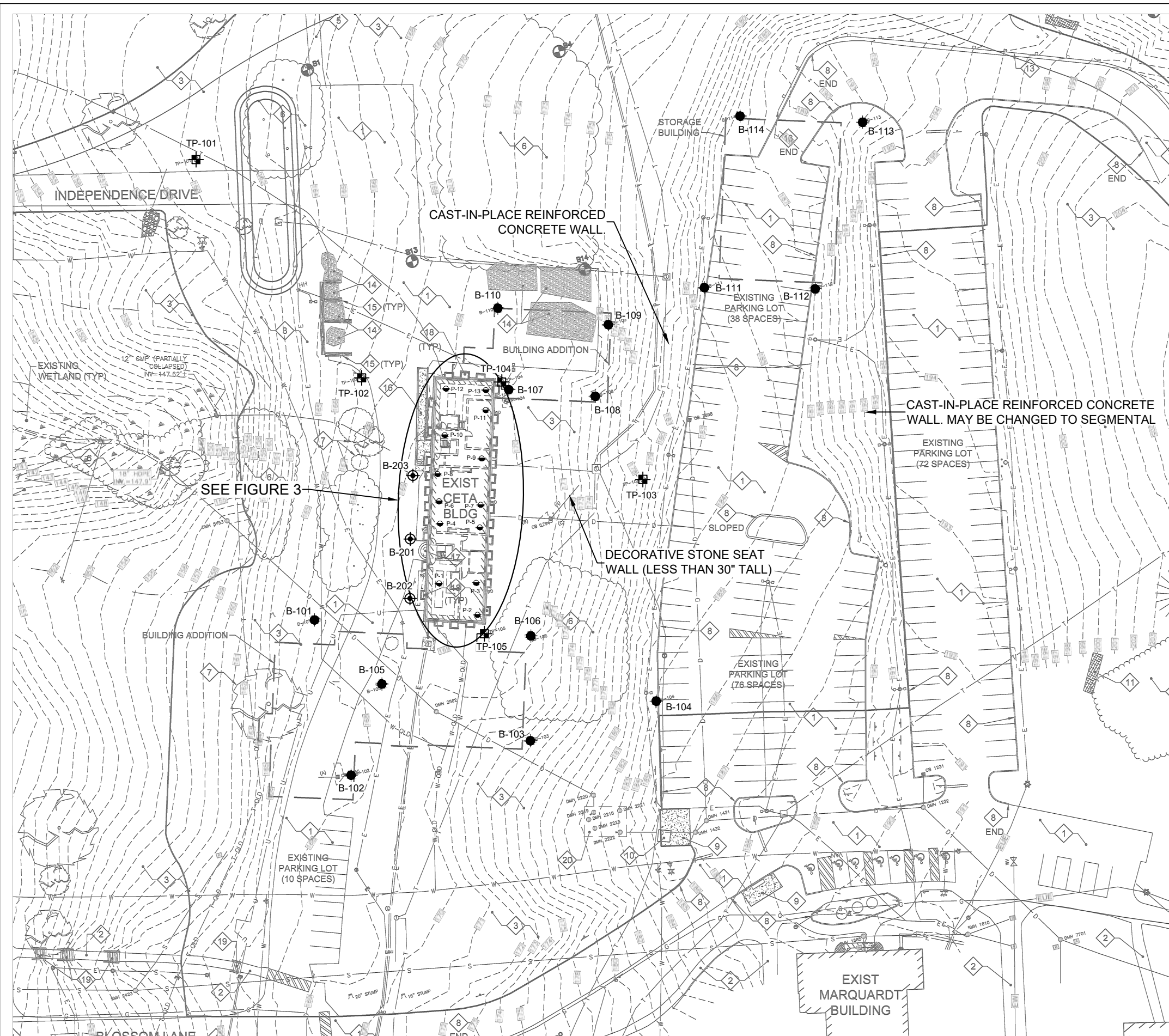
FIGURE 1  
LOCUS MAP  
GEOTECHNICAL ENGINEERING EVALUATION  
PROPOSED MAINE DEPARTMENT OF INLAND  
FISHERIES & WILDLIFE HEADQUARTERS  
AUGUSTA, MAINE

FEBRUARY 2024

PROJECT NO. 0767-166



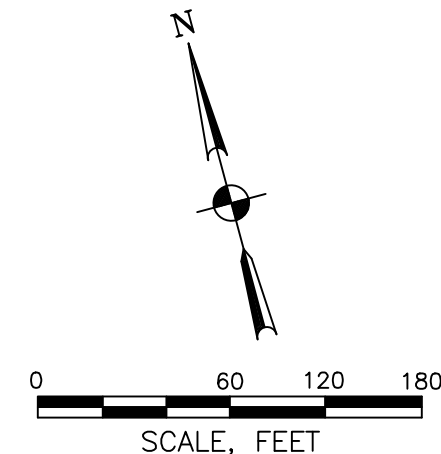




# **LEGEND:**

- P-1 APPROXIMATE LOCATION OF SOIL PROBES DRILLED 10 & 11 JUNE 2024.
- B-201 APPROXIMATE LOCATION OF SOIL BORING DRILLED 21 MAY 2024.
- B-101 APPROXIMATE LOCATION OF SOIL BORING DRILLED 06 AND 07 DECEMBER 2023.
- TP-101 APPROXIMATE LOCATION OF TEST PIT EXCAVATED 14 DECEMBER 2023.
- B APPROXIMATE LOCATION OF SOIL BORING DRILLED 23 AND 24 SEPTEMBER 2022.

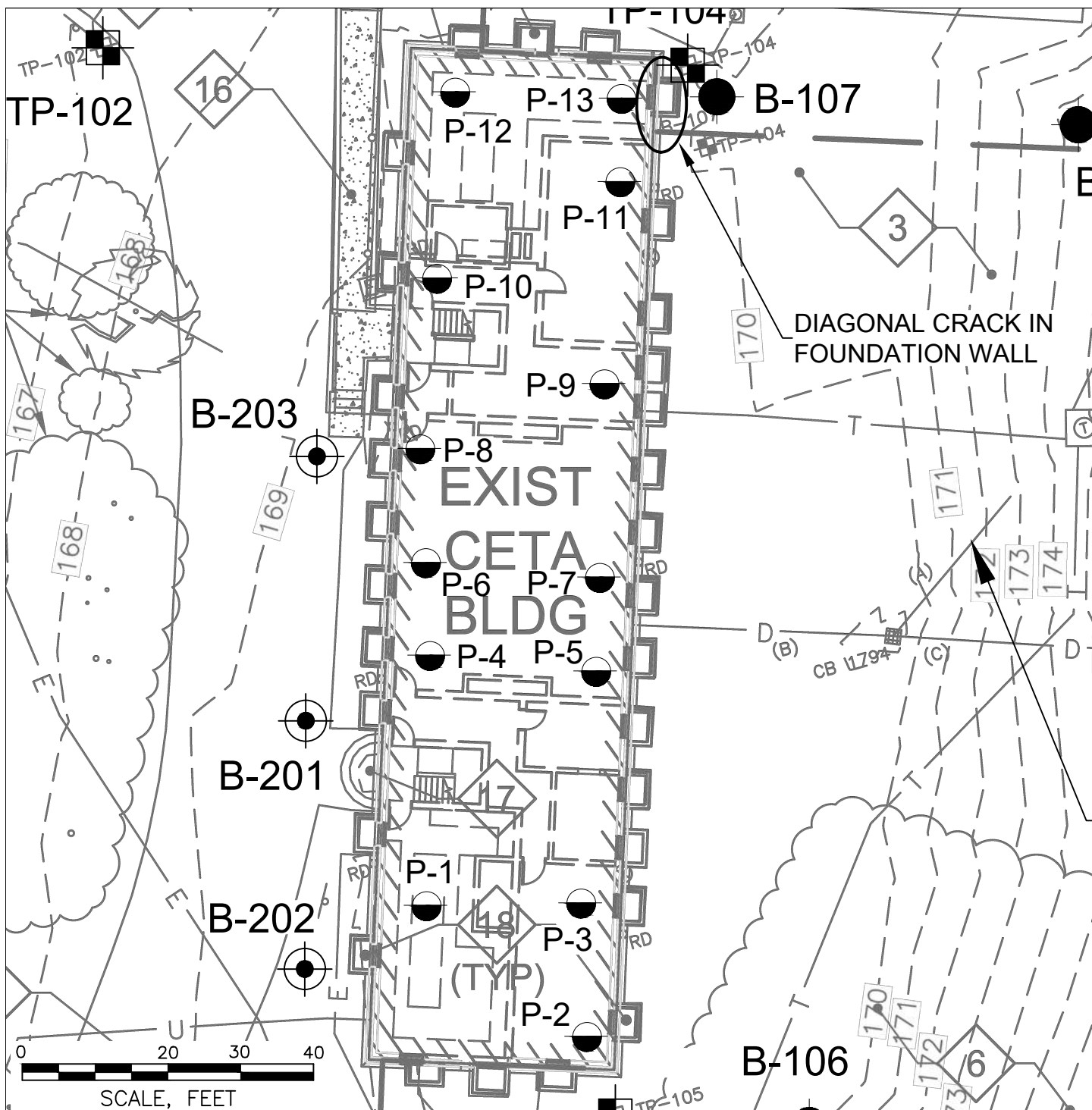
**SOURCE:**  
DRAWING NO. CX101, TITLED "EXISTING CONDITIONS PLAN", PREPARED BY OAK POINT ASSOCIATES, DATED 03/13/2024, MARKED "DESIGN DEVELOPMENT".







**FIGURE 2**  
**EXPLORATION LOCATION PLAN**  
**GEOTECHNICAL ENGINEERING EVALUATION**  
**PROPOSED MAINE DEPARTMENT OF INLAND**  
**FISHERIES & WILDLIFE HEADQUARTERS**  
**AUGUSTA, MAINE**

JULY 2024

PROJECT NO. 0767-166



#### LEGEND:

-  P-1 APPROXIMATE LOCATION OF SOIL PROBES DRILLED 10 & 11 JUNE 2024.
-  B-201 APPROXIMATE LOCATION OF SOIL BORING DRILLED 21 MAY 2024.
-  B-101 APPROXIMATE LOCATION OF SOIL BORING DRILLED 06 AND 07 DECEMBER 2023.
-  TP-101 APPROXIMATE LOCATION OF TEST PIT EXCAVATED 14 DECEMBER 2023.



**FIGURE 3**  
**BASEMENT EXPLORATION LOCATION PLAN**  
**GEOTECHNICAL ENGINEERING EVALUATION**  
**PROPOSED MAINE DEPARTMENT OF INLAND**  
**FISHERIES & WILDLIFE HEADQUARTERS**  
**AUGUSTA, MAINE**

JULY 2024

PROJECT NO. 0767-166



**SOURCE:**  
 DRAWING NO. CX101, TITLED "EXISTING CONDITIONS PLAN", PREPARED BY OAK POINT ASSOCIATES, DATED 03/13/2024, MARKED "DESIGN DEVELOPMENT".

**APPENDIX A**  
**LIMITATIONS**

Geotechnical Engineering Evaluation  
Proposed Maine Department of Inland Fisheries & Wildlife Headquarters  
Augusta, Maine



## **LIMITATIONS**

This evaluation has been limited considering the geotechnical engineering aspects of the proposed additions and modifications to the CETA building and construction of a new storage building at 27 Independence Drive in Augusta, Maine. The primary purpose of the evaluation was to obtain information regarding subsurface conditions on which to base recommendations about the geotechnical aspects of design and construction of foundations, ground floor slabs, and seismic considerations. This report identifies construction considerations intended to solely assist engineers that will design the project and monitor its construction, and not to the benefit of others, including but not limited to the Contractor. This report is not a technical specification, nor intended to be used as a specification for bidding or building the project.

This geotechnical evaluation might also aid contractors responsible for constructing the additions. However, the recommendations and comments provided in this report are not intended to be instructions or directives to the project Contractors. The project Contractors must evaluate construction issues encountered in the work based on their experience with similar projects, considering their methods and procedures.

RWG&A has not considered the construction from a worker safety perspective. Construction safety is the project Contractor's responsibility, who is solely responsible for the means, methods, and sequencing of construction operations. RWG&A is providing this information as a service to Oak Point Associates. Under no circumstances should this information be interpreted to mean that RWG&A, Oak Point Associates, and/or the Owner assume responsibility for construction site safety or the Contractor's activities; such responsibility is not implied and should not be inferred.

RWG&A's services excludes:

- Any environmental site assessment relative to oil and hazardous materials or evidence of a potential release or threat of oil or hazardous materials on, below, or around the site. (Note: any statement in this report, or on the exploration logs, regarding odors or unusual or suspicious conditions is for informational purposes only and is not intended to constitute an environmental assessment.)
- Any service to investigate or detect the presence of mold or other biological contaminants or any service designed or intended to prevent or lower the risk of an infestation of mold or other biological contaminants (MOBC infestation).
- Any service to evaluate shoreline stability or erosion potential, maximum sea levels, or sea level rise relative to the proposed construction.
- Any service to investigate or detect the presence of potentially hazardous subsurface vapor sources or any service designed or intended to prevent or lower the risk of vapor intrusion.

**APPENDIX B**

**BUILDING ADDITIONS AND STORAGE BUILDING SOIL BORING LOGS**

Geotechnical Engineering Evaluation  
Proposed Maine Department of Inland Fisheries & Wildlife Headquarters  
Augusta, Maine

RWG&A, Inc. soil descriptions are based on the following criteria. Descriptive terminology is used to denote the grain size and percentage of each component. The soil descriptions are based on visual-manual classification procedures, Standard Penetration Test results, and the results of laboratory testing on selected soil samples, where available. The Unified Soil Classification Group Symbol will be indicated in capital letters.

#### COMPONENT DEFINITIONS BY GRADATION SIEVE LIMITS

Materials	Definitions	Fractions	Upper	Lower
Boulders	Material too large to pass through an opening 12 in. square.			
Cobbles	Material passing through a 12 in. opening and retained on the 3 in. sieve.			
Gravel	Material passing the 3 in. sieve and retained on 1/4" (No. 4 sieve).	Coarse Fine	3 in. 3/4 in.	3/4 in. 1/4 in.
Sand	Material passing the No. 4 sieve and retained on the No. 200 sieve.	Coarse Medium Fine	No. 4 (1/4") No. 10 (1/8") No. 40 (1/32")	No. 10 (1/8") No. 40 (1/32") No. 200
Silt	Material passing the No. 200 sieve which is usually non-plastic in character and exhibits little or no strength when air dried.		No. 200	
Clay	Material passing the No. 200 sieve which can also be made to exhibit plasticity within a certain range of moisture contents and which exhibits considerable strength when air dried.		No. 200	

#### SOIL DESCRIPTION

##### General

Soils are described as to the Unified Soil Classification Systems Group Symbol, density or consistency, color, grain size distribution and other pertinent properties such as plasticity and dry strength. The RWG&A order of descriptors is as follows:

1. USCS Group Name and Symbol, or Fill
2. Density or Consistency
3. Moisture
4. Grain Size & Constituent percentages
5. Other pertinent descriptors
6. Color

#### DESCRIPTIVE TERMINOLOGY DENOTING COMPONENT PROPORTIONS

<u>Descriptive Terms</u>	<u>Range of Proportions</u>
Noun (major component)	≥50%
Adjective (secondary component)	20 - 50%
Some (third component)	25 - 45%
Little (second or third component)	15 - 25%
Few (second or third component)	5 - 15%
Trace	0 - 5%
With	Amount of component not determined. Used as a conjunction only. Does not indicate component percentile

#### OTHER DESCRIPTIVE TERMS

Where appropriate, geological classifications are also used (Glacial Till, etc.)

#### TYPICAL DESCRIPTIONS

SAND WITH SILT (SP-SM): Medium dense, moist, coarse to medium sand, few silt, brown.

FILL; Loose, dry, fine sand, some gravel and silt, with brick and concrete fragments, dark brown.

SILTY CLAY (CL); Very stiff, moist, silty clay, olive-brown.

<u>DENSITY OR CONSISTENCY OF SOILS</u>		
<u>COHESIVE SOILS</u>		
Consistency of Cohesive Soils	Standard Penetration Test (Blows Per Foot) (N)	Undrained Shear Strength (TSF)
Very Soft	0 - 2	Below 0.13 (250 psf)
Soft	2 - 4	0.13 to 0.25 (to 500 psf)
Medium	4 - 8	0.25 to 0.5 (to 1,000 psf)
Stiff	8 - 15	0.5 to 1.0 (to 2,000 psf)
Very Stiff	15 - 30	1.0 to 2.0 (to 4,000 psf)
Hard	Over 30	over 2.0 (over 4,000 psf)
Consistency of cohesive soils is based upon field vane shear, torvane, or pocket penetrometer, or laboratory vane shear or Unconsolidated-Undrained Triaxial Compression tests. Consistency of cohesive soils is based upon the Standard Penetration test when no other data is available.		
<u>COHESIONLESS SOILS</u>		
Density of Cohesionless Soils	Standard Penetration Test (Blows per Foot) (in)	
Very Loose	0 - 4	
Loose	4 - 10	
Medium Dense	10 - 30	
Dense	30 - 50	
Very Dense	over 50	
<u>PENETRATION RESISTANCE</u>		
STANDARD PENETRATION TEST (ASTM D1586) - a 2.0-inch diameter, 1-3/8 inch inside diameter split barrel sample is driven into soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The total number of blows required for penetration from 6 to 18 inches is the Standard Penetration Resistance (N).		
<u>COBBLES AND BOULDERS</u>		
The percentage of cobbles and boulders is estimated visually where possible.		
Descriptive Term	Estimated Percentage	
Very Few	0 - 10%	
Few	10 - 25%	
Common	25 - 40%	
Numerous	40 - 50%	
If the percentage cannot be determined, as in a typical test boring, then use “with” to indicate the presence of cobbles and/or boulders. (i.e., gravelly sand with cobbles and boulders).		
<u>FILLS</u>		
The following terminology is used to denote size range of man-made materials within fill deposits:		
Size Range	Comparative Soil Terms	
<No. 200 Sieve	Silt - size	
No. 200 to 1/4 in.	Sand - size	
1/4 in. to 3 in.	Gravel - size	
3 in. to 12 in.	Cobble - size	
>12 in.	Boulder - size	
<u>SUPPLEMENTAL SOIL DESCRIPTION TERMINOLOGY</u>		
Term	Example	
Seam	Typically 1/16 to 1/2 inch thick	1/4 inch sand seams
Layer	Greater than 1/2 inch thick	2-inch sand layers
Occasional	One or less per foot of thickness	
Frequent	More than one per foot of thickness	
Interbedded	Alternating soil layers of different composition	
Varved	Alternating thin seams of silt and clay	
Mottled	Variations in color	

# **Visual-Manual Rock Core Descriptors** (adapted from EM 1110-1-2908)

## **1. Rock type**

## **2. Intact Blocks of Rock**

### a. Hardness.

- (1) Very soft: Can be deformed or broken by hand, carved by knife, readily excavated with point of geologists pick.
- (2) Soft: Can be scratched with a fingernail, gouged or grooved readily with knife or geologists pick point.
- (3) Moderately hard: Can be scratched easily with a knife. Gouges or grooves to 1/4 in. by hard blow of point of geologists pick.
- (4) Hard: Can be scratched with difficulty with a knife or pick. Hard blow of hammer required to detach specimen.
- (5) Very hard: Cannot be scratched with a knife. Breaking hand specimens require several hard blows of geologists pick.

### b. Degree of Weathering.

- (1) Fresh: Few to no evidence of any chemical or mechanical alteration. Rock rings under hammer if crystalline.
- (2) Slightly weathered: Slight discoloration on surface, slight alteration along discontinuities, less than 10 percent of the rock volume altered. Rock rings under hammer if crystalline.
- (3) Moderately weathered: Discoloring evident, surface pitted and altered with alteration penetrating extends up to 1 in. below rock surfaces, weathering "halos" evident, 10 to 50 percent of the rock altered. Rock has dull sound under hammer.
- (4) Highly weathered: Entire mass discolored, alteration pervading nearly all of the rock with some pockets of slightly weathered rock noticeable, some minerals leached away. Rock "clunks" when struck.
- (5) Decomposed: Rock reduced to a soil with relict rock texture, generally molded and crumbled by hand.

### c. Texture.

Texture (Note 1)	Grain Diameter	Particle Name	Rock Name
Sedimentary rocks			
*	80 mm	cobble	conglomerate
*	5 - 80 mm (1/4 - 3 in)	gravel	
Coarse grained	2 - 5 mm (1/16 - 1/4 in)		
Medium grained	0.4 - 2 mm (1/64- 1/16 in)	sand	sandstone
Fine grained	0.1 - 0.4 mm (Barely seen to 1/64 in)		
Very fine grained	Too small to be seen	clay, silt	shale, claystone, siltstone
Igneous and metamorphic rocks			
Coarse grained	5 mm (1/4 in)		
Medium grained	1 - 5 mm (1/32 in to 1/4 in)		
Fine grained	0 - 1 mm ( Too small to be seen to 1/32 in)		
Aphanite	(0.1 mm) Barely seen		
<p>* Use clay-sand texture to describe conglomerate matrix.</p> <p>Note: Use simple standard textural adjectives such as porphyritic, vesicular, pegmatitic, granular, and grains well developed, but not sophisticated terms such as holohyaline, hypidimorphic granular, crystal loblastic, and cataclastic.</p>			

- d. Lithology Macro Description of Mineral Components: Use standard adjectives such as shaly, sandy, silty, and calcareous. Note inclusions, concretions, nodules, etc.



### 3. Rock Structure

Thickness of Bedding and Foliation	Degree of Fracturing (Jointing)	Dip of Bedding or Fracture.
Massive: 3-ft thick or greater	Sound: fracture spacing - 6 ft or more	Horizontal: 0 to 5 degrees.
Thick bedded: beds from 1 ft. to 3-ft thick.	Slightly fractured: fracture spacing - 2 ft. to 6 ft.	Shallow or low angle: 5 to 35 degrees
Medium bedded: beds from 4 in. to 1-ft thick.	Moderately fractured: fracture spacing - 8 in. to 2 ft.	Moderately dipping: 35 to 55 degrees
Thin bedded: 4 in. thick or less.	Highly fractured: fracture spacing - 2 in. to 8 in	Steep or high angle: 55 to 85 degrees
	Extremely or Intensely fractured: fracture spacing - 2 in. or less	Vertical: 85 to 90 degrees

### 4. Discontinuities

#### a. Joints.

(1) Type: Type of joint if it can be readily determined (i.e., bedding, cleavage, foliation, schistosity, or extension).

(2) Degree of joint wall weathering:

(i) Unweathered: No visible signs are noted of weathering; joint wall rock is fresh, crystal bright.

(ii) Slightly weathered joints: Discontinuities are stained or discolored and may contain a thin coating of altered material. Discoloration may extend into the rock from the discontinuity surfaces to a distance of up to 20 percent of the discontinuity spacing.

(iii) Moderately weathered joints: Slight discoloration extends from discontinuity planes for greater than 20 percent of the discontinuity spacing. Discontinuities may contain filling of altered material. Partial opening of grain boundaries may be observed.

(iv) Highly weathered joints: same as Item 2.b.(4).

(v) Completely weathered joints: same as Item 2.b.(5).

(3) Joint wall separations: General description of separation if it can be estimated from rock core; open or closed; if open note magnitude; filled or clean.

(i) Very tight: separations of less than 0.004 inch (0.1 mm).

(ii) Tight: separations between 0.004 and 1/64 inch (0.1 and 0.5 mm).

(iii) Moderately open: separations between 1/64 and 1/8 inch (0.5 and 2.5 mm).

(iv) Open: separations between 1/8 and 1/2 inch (2.5 and 10 mm).

(v) Very wide: separations between 1/2 inch and 1 inch (10 and 25 mm).

For separations greater than 1 inch (25 mm) the discontinuity should be described as a major discontinuity.

(4) Roughness:

(i) Very rough: Near vertical ridges occur on the discontinuity surface.

(ii) Rough: Some ridges are evident; asperities are clearly visible and discontinuity surface feels very abrasive.

(iii) Slightly rough: Asperities on the discontinuity surface are distinguishable and can be felt.

(iv) Smooth: Surface appears smooth and feels so to the touch.

(v) Slickensided: Visual evidence of polishing exists.

(5) Infilling: Source, type, and thickness of infilling; altered rock, or by deposition; clay, silt, etc.; how thick is the filler.

(6) Joint orientation

#### b. Faults and Shear Zones.

(1) Extent: Single plane or zone; how thick.

(2) Character: Crushed rock, gouge, clay infilling, slickensides.

#### c. Cavities, voids,

**5. Rock Quality Designation:** RQD in % = (Length of Core in Pieces > 4 in and longer)/(Length of run)\*100

Example: Rock type, degree of weathering, hardness, texture, structure, condition of discontinuities, color, alteration.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth: 15'

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	FILL; Topsoil and organic material (6 inches).	15	4	5			
		S-2	FILL: Silty sand, moist, coarse to fine sand, some silt, light gray.	17	3 2 2 2 2 2 2 2 2	4			
5		S-3	SILTY SAND (SM); Silty sand, loose to very loose, moist, coarse to fine sand, some silt, light gray.	18	3 2 2 2 2 2	4			
10		S-4		17	2 1 1 2	2			
15		S-5	SILTY SAND WITH GRAVEL (SM); Medium dense, wet, coarse to fine sand, some silt, little gravel, light brown to gray.	12	3 7 8 10	15			
20			Bottom of exploration at 17.5'; Auger refusal on possible bedrock.						
25									
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth: 18'

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	FILL; Topsoil and organic material (6 inches).	18	2 2 3 5	5			0
			FILL; Silty sand with gravel, dry, coarse to fine sand, some silt, few gravel, gray-brown.						
5		S-2	FILL; Sand with silt and gravel, dry, coarse to fine sand, few silt, little gravel, coal and slag fragments, black.	15	1 1 1	2			2
		S-3	SANDY SILT (ML); Loose, moist, silt, some sand, trace to few gravel, light brown.	16	1 3 2 2 2 2 3 4	4			0
10		S-4		0		5			0
15		S-5		20	4 4 4 4	8			0
			SILTY CLAY (ML-CL); Silty clay, medium, wet, few medium to fine sand, silt, gray.						
20		S-6		17	1 1 2 1	3			0
			Advanced rod probe.						
25			Possible gravel.						
			Bottom of exploration at 26.1'; Rod probe refusal on possible bedrock.						
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: Rotary Wash  
Casing Type: 4" Diameter Steel

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	FILL; Silty sand with gravel, dry, coarse to fine sand, some silt, few gravel, gray-brown.	24					GS HYD ATT CON LV
		S-2							
		S-3							
5			Refer to boring log B-102.						
10									
15									
20		U-1	SILTY CLAY (ML-CL); Silty clay, medium, wet, few medium to fine sand, silt, gray.						
			Bottom of exploration at 21.0'; Not refusal.						
25									
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			S-1	FILL; Topsoil and organic material (6 inches).	13	2	14			0.1
			S-2	FILL; Silty sand, moist, coarse to fine sand, trace to few gravel, some silt, brown to light brown.	14	9	6			0
			S-3	SILTY SAND (SM); Loose, moist, fine sand, some silt, trace gravel, light brown.	14	5	9			0
5				Denser, little to some gravel.		4				
						4				
						4				
						5				
						4				
10				Bottom of exploration at 9.6'; Auger refusal on possible bedrock.						
15										
20										
25										
30										

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: Rotary Wash  
Casing Type: 4" Diameter Steel

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	FILL; Topsoil and organic material (6 inches).	12	1	8			
		S-2	FILL; Silty sand with gravel, moist, coarse to fine sand, few to little silt, little gravel, trace reclaim asphalt, brown.	12	3	8			
		S-3A		17	5	8			
5		S-3B	SILTY SAND (SM); Loose to medium dense, moist, fine sand, some silt, trace root fibers at top of deposit.		2				
					3				
					5				
10		R-1	SCHIST; Hard, fresh to slightly weathered, fine grained; medium to thick bedded, slightly fractured, high angle to vertical joints, slightly weathered open to tight, smooth to slightly rough, RQD = 70% Unconfined compressive strength = 15,200 psi	54				UC	
15			Bottom of exploration at 14.9'.						
20									
25									
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth: 15'

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			S-1	FILL; Topsoil and organic material (6 inches).	15	1 2 2	4			
			S-2	FILL; Sandy silt, wet, silt, some coarse to fine sand, few fine gravel, few coal and brick fragments, gray.	14	2 3 2 3 3	7	19.4	MC GS	
			S-3		19	4 3 3 3 2 2	5			
5				SILTY SAND (SM); Loose, moist, coarse to fine sand, some silt, light gray.						
			S-4	Light brown to gray.	18	2 2 3 2	5			
10										
			S-5	More silt, few clay. Few gravel, no clay.	16	3 2 4 5	6			
15				Bottom of exploration at 17.7'; Refusal on bedrock.						
20										
25										
30										

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	TOPSOIL AND ORGANIC MATERIAL (6 inches).	13	1	4			0
		S-2	SILT (ML); Loose to medium dense, dry to wet, few medium to fine sand, trace fine gravel, light brown.	16	2 2 3 4 5 5 7 13	10	25.9	MC GS	0
5		S-3	Trace to few gravel. Bottom of exploration at 5.5'; Auger refusal on possible bedrock.	4	50/0"	50+			0
10									
15									
20									
25									
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.





Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	TOPSOIL AND ORGANIC MATERIAL (6 inches).	16	1	3			
		S-2	SILT WITH SAND (ML); Loose, dry to wet, silt, few medium to fine sand, trace fine gravel, light brown.	16	1 2 2 3 3 5 6	8			
5		S-3		17	4 4 5 5 6	10	27	MC GS	
10		S-4	Bottom of exploration at 10.8'.	8	12 50/4"				
15									
20									
25									
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



- Sheet 1 of 1

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	TOPSOIL AND ORGANIC MATERIAL (8 inches).	16	2 3 8 8	11			
			SILTY SAND WITH GRAVEL (SM); Medium dense, moist, coarse to fine sand, little to some silt, light brown to brown.						
5			Bottom of exploration at 3.7'; Auger refusal on possible bedrock.						
10									
15									
20									
25									
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	ASPHALT PAVEMENT (3 inches).	16	3	9	14.5	MC GS	
		S-2	FILL; Silty sand, moist to wet, coarse to fine sand, some silt, few fine gravel, brown.		4				
					5				
					5				
					2				
			SILTY SAND (SM); Loose, dry, fine sand, some silt, light brown.	16	4	8			
5		S-3			3				
					3				
					3				
					4				
				16	5	31			
10		S-4	SILTY SAND WITH GRAVEL (SM); Medium dense, moist, coarse to fine sand, little to some silt, little gravel, light brown to brown.		10				
					11				
					20				
					22				
			Bottom of exploration at 12.5'.						
15									
20									
25									
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	FILL; Topsoil and organic material (4 inches).	15	5	15			
		S-2	FILL; Sand with silt and gravel, dry, coarse to fine sand, few silt, brown.	13	7	13			
		S-3	SILT (ML); Loose, dry to moist, silt, few medium to fine sand, light brown.	18	8	6			
5			Bottom of exploration at 6.9'; Auger refusal on possible bedrock.		5				
10									
15									
20									
25									
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-112

Total Depth (ft): 6.9

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	TOPSOIL AND ORGANIC MATERIAL (6 inches).	15	2	11			
		S-2	SILTY SAND (SM); Medium dense, dry, coarse to fine sand, little to some silt, little gravel, light brown.	0	3				
					8				
					19	23			
					12				
					12				
					11				
5		S-3		5	6	22	24.2	MC	
					3				
					7				
					15				
			Bottom of exploration at 6.9'; Auger refusal on possible bedrock.		50/1"				
10									
15									
20									
25									
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-113

Total Depth (ft): 8.6

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			S-1	FILL; Topsoil and organic material (6 inches).	12	1 3 12 50/5"	15			
				FILL; Silty sand.						
				SILTY SAND WITH GRAVEL (SM); Loose to medium dense, dry, coarse to fine sand, little to some silt, few to little gravel, light brown.						
5			S-2	Trace gravel.	16	5 7 9 8	16	22.1	MC	
				Bottom of exploration at 8.6'; Auger refusal on possible bedrock.						
10										
15										
20										
25										
30										

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-114

Total Depth (ft): 4.8

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings  
Observed Water Depth:

Drilling Co.: Northern Test Boring  
Drill Rig: Diedrich D-50  
Driller Rep.: Mike Nadeau  
Date Started: 12/06/23  
Date Completed: 12/06/23  
Surface Elevation:  
Drilling Method: 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	FILL; Topsoil and organic material (6 inches).	12	1 3 12 50/5"	15			
			FILL; Silty sand and gravel, dry, coarse to fine sand, some silt, some gravel, possible cobbles or boulders, light brown.						
5			Bottom of exploration at 4.8'; Auger refusal on possible bedrock.						
10									
15									
20									
25									
30									

Notes: Reported SPT hammer energy transfer ratio is about 93 percent. SPT N-values are uncorrected for energy transfer.





Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings and cold path  
Observed Water Depth: 10'

Drilling Co.: New England Boring Contractors  
Drill Rig: Mobile Drill B-53  
Driller Rep.: Tom Schafer  
Date Started: 05/23/24  
Date Completed: 05/23/24  
Surface Elevation: 169.3 Feet  
Drilling Method: SSA to 10', 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	ASPHALT (4.5 inches).	14	7 5 6 3				
			FILL; Sand and gravel, dry, coarse to fine sand, few silt, little gravel, tan.						
			FILL; Sand with silt and gravel, dry, coarse to fine sand, few silt, little gravel, few coal, slag, black.						
			Auger action indicates softer strata (SANDY SILT).						
5		S-2	CLAYEY SILT (ML-CL); Medium, moist to wet, trace fine sand, silt, few to little clay, olive.	20	2 3 3 4	6			
10		S-3	Weathered bedrock, relic rock structure.	14	15 43 50/5"	93+			
			Bottom of exploration at 13.7'; Auger refusal on bedrock.						
15									
20									
25									
30									

Notes: N-Values are uncorrected for energy transfer ratio.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings and cold path  
Observed Water Depth: 10'

Drilling Co.: New England Boring Contractors  
Drill Rig: Mobile Drill B-53  
Driller Rep.: Tom Schafer  
Date Started: 05/23/24  
Date Completed: 05/23/24  
Surface Elevation: 169.1 Feet  
Drilling Method: SSA to 10', 2 1/4" HSA  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	ASPHALT (4.5 inches).	24	4 6 4 2				
			FILL; Sand and gravel, dry, coarse to fine sand, few silt, little gravel, tan.						
			FILL; Sand with silt and gravel, dry, coarse to fine sand, few silt, little gravel, few coal, slag, black.						
			FILL; Sand and gravel, dry, coarse to fine sand, few silt, little gravel, tan.						
5		S-2	CLAYEY SILT (ML-CL); Very soft to medium, moist to wet, trace sand, silt, few to little clay, olive. Pocket Penetrometer: Undrained Shear Strength: Su = 2.5 tsf	24	WOH		24.9	GS MC	
10		S-3	Weathered bedrock, relic rock structure.	15	26 46 50/3"	96+			
			Bottom of exploration at 11.7'; Auger refusal on bedrock.						
15									
20									
25									
30									

Notes: N-Values are uncorrected for energy transfer ratio.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Tom Snow  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with cuttings and cold path  
Observed Water Depth: 10'

Drilling Co.: New England Boring Contractors  
Drill Rig: Mobile Drill B-53  
Driller Rep.: Tom Schafer  
Date Started: 05/23/24  
Date Completed: 05/23/24  
Surface Elevation: 169.0 Feet  
Drilling Method: SSA to 10', Rotary Wash  
Casing Type: 4" HW to 18.5'

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			ASPHALT (2 inches).						
		S-1	Auger action indicates sand and gravel fill.	10	5	14			
			FILL; Sand with silt and gravel, dry, coarse to fine sand, few silt, little gravel, tan to gray.		7				
		S-2	CLAYEY SILT (ML-CL); Very soft to medium, moist to wet, few sand, silt, few clay, mottled, olive.	20	6	5			
					2				
5		S-3	Pocket Penetrometer: Undrained Shear Strength: Su = 1.5 tsf	18	3	2	24.4	MC	
					2				
		S-4		20	3	1			
					3				
		S-5	Pocket Penetrometer: Undrained Shear Strength: Su = 1.0 to 1.5 tsf	18	1	3	35.6	GS	
10					1			MC	
		S-6	Pocket Penetrometer: Undrained Shear Strength: Su = 0.75 tsf	8	1	10	23.1	HYD	
					2			ATT	
		S-7	Pocket Penetrometer: Undrained Shear Strength: Su = 1.25 to 1.5 tsf	20	2	6	23.2	MC	
					4				
15					5				
					5				
					6				
					2				
					3				
					3				
		R-1	Weathered bedrock.						
20		R-2	BIOTITE-SCHIST; Hard, fresh, fine grained, quartz inclusion at 19.2'; massive, sound; unweathered joints, closed, quartz and calcite filled joints, moderately dipping to high angle; RQD = 85%					QU	
			Bottom of exploration at 23.5'; Boring terminated in bedrock.						
25									
30									

Notes: 1) Casing Type and Size Continued: Telescope 3" HW to 18.5

2) N-Values are uncorrected for energy transfer ratio. Reported energy transfer ratio is about XXX percent.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: 1.6

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/10/24  
Date Completed: 06/10/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			Concrete slab (7 inches).						
		S-1	ROCK FILL; Angular, coarse to fine gravel.	24					
			CLAYEY SILT (ML-CL); Wet, silt, little clay, few fine sand, gray.						
		S-2	SILTY CLAY (CL); Very soft to soft, wet, clay, some silt, trace sand, gray.	24					
5		S-3		18					
			Pocket Penetrometer: Undrained Shear Strength: $S_u = 0.25$ ksf						
			Bottom of exploration at 6.6'; Probe refusal on possible cobble, boulder, or bedrock.						
10									
15									
20									
25									
30									

Notes: Exploration rod moves downward with little hand push resistance.



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: Not Obs.

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/10/24  
Date Completed: 06/10/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	Concrete slab (5 inches).	22					
			CRUSHED ROCK FILL; Angular, coarse to fine gravel.						
			CLAYEY SILT (ML-CL); Wet, silt, few to little clay, little sand, gray.						
			Weathered rock.						
			Bottom of exploration at 2.6'; Refusal surface on possible cobble, boulder, or bedrock.						
5									
10									
15									
20									
25									
30									

Notes: Groundwater not observed at P-2 due to flooded condition.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: P-3

Total Depth (ft): 2.7

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: 1.1'

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/10/24  
Date Completed: 06/10/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	Concrete slab (5 inches).	22					
			ROCK FILL; Rounded to subrounded, coarse to fine gravel.						
			CLAYEY SILT WITH SAND (ML-CL); Wet, silt, few to little clay, little fine sand, gray.						
			Bottom of exploration at 2.7'; Refusal on possible cobble, boulder, or bedrock.						
5									
10									
15									
20									
25									
30									

Notes:



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: 1.4'

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/10/24  
Date Completed: 06/10/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			Concrete slab (5 inches).						
		S-1	ROCK FILL; Subrounded, coarse to fine gravel.	22					
			CLAYEY SILT (ML-CL); Wet, silt, some clay, trace sand, gray.						
		S-2		22					
5		S-3		0					
		S-4	SILTY CLAY (CL); Wet, clay, some silt, gray.	12					
			Bottom of exploration at 7.4'; Refusal on possible cobble, boulder, or bedrock.						
10									
15									
20									
25									
30									

Notes: 1) Geoprobe sample advanced through soil with little resistance.  
2) Weathered rock observed at probe tip.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: P-5

Total Depth (ft): 4.5

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: 1'

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/10/24  
Date Completed: 06/10/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	Concrete slab (5 inches).	20					
			ROCK FILL; Angular and subrounded, coarse to fine gravel.						
		S-2	SILT WITH SAND (ML); Moist, silt, little medium to fine sand, few clay, gray.	20					
5			Bottom of exploration at 4.5'; Refusal on possible cobble, boulder, or bedrock.						
10									
15									
20									
25									
30									

Notes:





**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: P-6

Total Depth (ft): 4.7

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: 1'

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/10/24  
Date Completed: 06/10/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			Concrete slab (5 inches).						
		S-1	ROCK FILL; Rounded, coarse to fine gravel.	12					
		S-2	CLAYEY SILT WITH SAND (ML-CL); Moist to wet, silt, little to few medium to fine sand, little clay, gray to brown. Interbedded sand layers.	12					
5			Bottom of exploration at 4.7'; Refusal on possible cobble, boulder, or bedrock.						
10									
15									
20									
25									
30									

Notes:



**R.W. Gillespie  
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- Materials Testing Services


Boring Log: P-7

Total Depth (ft): 4.6

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth:

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/10/24  
Date Completed: 06/10/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	Concrete slab (4 inches).	15					
			ROCK FILL; Rounded, coarse to fine gravel.						
		S-2	SILT WITH SAND AND CLAY (ML-CL); Moist, silt, little medium to fine sand, trace clay, gray to brown. Few to little clay.	20					
			Weathered rock.						
5			Bottom of exploration at 4.6'; Refusal on possible cobble, boulder, or bedrock.						
10									
15									
20									
25									
30									

Notes:



**R.W. Gillespie  
& Associates**

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- Materials Testing Services

Boring Log: P-8

Total Depth (ft): 4.8

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: 1'

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/10/24  
Date Completed: 06/10/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			S-1	Concrete slab (4 inches).	12					
			S-2	ROCK FILL; Rounded and angular, coarse to fine gravel.						
				CLAYEY SILT WITH SAND (ML-CL); Moist, little clay, little coarse to fine sand, gray.	12					
5				Bottom of exploration at 4.8'; Refusal on possible cobble, boulder, or bedrock.						
10										
15										
20										
25										
30										

Notes:



**R.W. Gillespie  
& Associates**

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- Materials Testing Services


Boring Log: P-9

Total Depth (ft): 2.7

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: 1.1'

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/11/24  
Date Completed: 06/11/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	Concrete slab (4.5 inches).	20					
			ROCK FILL; Rounded and angular, coarse to fine gravel.						
			CLAYEY SILT (ML-CL); Wet, silt, little clay, few sand, gray.						
			Bottom of exploration at 2.7'; Refusal on possible cobble, boulder, or bedrock.						
5									
10									
15									
20									
25									
30									

Notes:



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: 5'

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/10/24  
Date Completed: 06/10/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0		S-1	Concrete slab (4 inches)	12					
			Clay pipe 5" diameter.						
		S-2	CLAYEY SILT WITH SAND (ML-CL); Loose to medium dense, wet, silt, some clay, broken earth pipe fragment, little coarse to fine sand, gray. Pocket Penetrometer: Undrained Shear Strength: Su = 1.5 ksf	20					
5		S-3	SANDY SILT WITH GRAVEL (ML); Loose, wet, silt, some fine sand, trace clay, little fine gravel, gray. Pocket Penetrometer: Undrained Shear Strength: Su = 1.0 ksf	18					
		S-4		12					
			Bottom of exploration at 8.3'; Refusal on possible cobble, boulder, or bedrock.						
10									
15									
20									
25									
30									

Notes: Clay pipe encountered. Broken pipe fragment removed and explored beneath the pipe.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: P-11

Total Depth (ft): 4.9

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: Not Obs.

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/11/24  
Date Completed: 06/11/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			Concrete slab (4.8 inches).						
		S-1	ROCK FILL; Rounded, coarse to fine gravel.	6					
		FV-1	CLAYEY SILT WITH SAND (ML-CL); Very loose, wet, silt, little clay,	20					
		S-2	little coarse to fine sand, gray.						
			Field Vane: Undrained Shear Strength: Su = 480 psf						
		S-3	Few fine gravel, interbedded fine sand 5".	10					
5			Trace to few clay.						
			Bottom of exploration at 4.9'; Refusal on possible cobble, boulder, or bedrock.						
10									
15									
20									
25									
30									

Notes:



Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: 3'

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/11/24  
Date Completed: 06/11/24  
Surface Elevation:  
Drilling Method: Geoprobe  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			Concrete slab (4.5 inches).						
		S-1	ROCK FILL; Rounded cobbles, coarse to fine gravel.	0					
		FV-1	SILT WITH SAND (ML); Medium dense, moist, some fine sand, trace clay, gray.	20					
		S-2	Field Vane: Undrained Shear Strength: Su = 2300 psf						
		FV-2	SILTY CLAY (CL); Very stiff, wet, clay, some silt, trace sand, gray.	20					
5		S-3	Field Vane: Undrained Shear Strength: Su = 2380 psf						
		S-4	SANDY SILT WITH CLAY (ML-CL); Wet, silt, fine sand, few clay, gray.	10					
			Bottom of exploration at 7.8'; Refusal on possible cobble, boulder, or bedrock.						
10									
15									
20									
25									
30									

Notes: Sample 1, observed from tip of sampler.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: P-13

Total Depth (ft): 7.2

Sheet 1 of 1

Project Name: Prop. Maine Dept. of Inland Fisheries & Wildlife HQ  
RWG&A Project No. 0767-166-23  
Location: Augusta, Maine  
Client: Oak Point Associates  
RWG&A Representative: Temitope Omokinde  
Boring Location: See Exploration Location Plan  
Boring Abandonment Method: Backfill with sand and concrete  
Observed Water Depth: 3'

Drilling Co.: Bronson Drilling  
Drill Rig: Geoprobe Bosch Hammer  
Driller Rep.: Bronson  
Date Started: 06/11/24  
Date Completed: 06/11/24  
Surface Elevation:  
Drilling Method:  
Casing Type:

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS	PID (PPM)
0			S-1	Concrete slab (3.5 inches).	12					
				POORLY GRADED GRAVEL (GP); Coarse, angular gravel.						
			S-2	SAND WITH SILT (SP-SM); Moist, few silt, trace clay.	20					
				Interbedded clay seams.						
			FV-1	CLAYEY SILT WITH SAND (ML-CL); Loose, moist to wet, silt, little clay, few to little fine sand, gray.	20					
5			S-3	Field Vane: Undrained Shear Strength: Su = 630 psf						
				SANDY SILT WITH CLAY (ML-CL); Wet, silt, some fine sand, little to few clay, trace fine gravel, black fragment, gray.						
				Bottom of exploration at 7.2'; Refusal on possible cobble, boulder, or bedrock.						
10										
15										
20										
25										
30										

Notes:



**APPENDIX C**

**FOUNDATION TEST PIT LOGS**

Geotechnical Engineering Evaluation  
Proposed Maine Department of Inland Fisheries & Wildlife Headquarters  
Augusta, Maine



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

## TEST PIT LOG

### Test Pit No. TP-104

PROJECT	Proposed Maine Dep of Inland Fisheries & Wildlife HQ	PROJECT NO.	0767-166-23
CLIENT	Oak Point Associates	DATE	12/14/23
LOCATION	Augusta, Maine	ELEV.	
EXCAVATION METHOD	Spencer Earthworks - Yanmar Vio35	LOGGER	Tom Snow
EXCAVATION LOCATION	Near northeast corner of CETA building		
DEPTH TO - Water:	Not Obs.	When checked:	Caving:

DEPTH	SYMBOL	SAMPLES	DESCRIPTION	MOISTURE %	LAB TESTS
0			FILL; Silty sand, moist, fine sand, few to little silt, little gravel, brown.		
5			FILL; Well rounded coarse gravel and cobbles with sand and silt. Approximately 80% gravel and cobbles. Approximately 20% silt and sand.		
10			Bottom of exploration at 8.0'; Top of footer.		
15					
20					
25					

Notes: Oak Point Associates' representative on site to log footing condition and exposed dimensions.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

## TEST PIT LOG

### Test Pit No. TP-105

PROJECT	Proposed Maine Dep of Inland Fisheries & Wildlife HQ	PROJECT NO.	0767-166-23
CLIENT	Oak Point Associates	DATE	12/14/23
LOCATION	Augusta, Maine	ELEV.	
EXCAVATION METHOD	Spencer Earthworks - Yanmar Vio35	LOGGER	Tom Snow
EXCAVATION LOCATION	Near southeast corner of CETA building		
DEPTH TO - Water:	Not Obs.	When checked:	Caving:

DEPTH	SYMBOL	SAMPLES	DESCRIPTION	MOISTURE %	LAB TESTS
0			FILL; Silty sand, moist, fine sand, little silt, brown.		
5			FILL; Well rounded coarse gravel and cobbles with sand and silt. Approximately 80% gravel and cobbles. Approximately 20% silt and sand.		
			Top of footer at 8'.		
10			Bottom of exploration at 9.0'.		
15					
20					
25					

Notes: Oak Point Associates' representative on site to log footing condition and exposed dimensions.

**APPENDIX D**

**MARK HAMPTON STORMWATER MANAGEMENT TEST PIT LOGS**

Geotechnical Engineering Evaluation  
Proposed Maine Department of Inland Fisheries & Wildlife Headquarters  
Augusta, Maine



MARK HAMPTON ASSOCIATES, INC.

SOIL EVALUATION • WETLAND DELINEATIONS • SOIL SURVEYS • WETLAND PERMITTING

7745

December 18, 2023

Mr. Erik J. Wiberg, PE  
R. W. Gillespie & Associates, Inc.  
20 Pomerleau Street Suite 100  
Biddeford, ME 04005

Re: Soil Test Pit Evaluation, Proposed MDIFW Building Blossom Lane and Independence Drive Augusta, ME

Dear Erik,

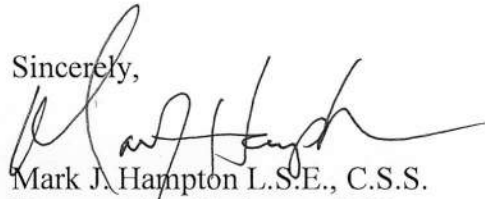
I completed evaluation of five backhoe dug test pits, three of which were evaluated for potential stormwater management and two for evaluation of the foundation of the existing building onsite. The soil evaluation was conducted in accordance with Section 7.D.4 of the Stormwater Management Rules. The test pits 101-103 were dug in the proposed stormwater device areas and testpits 104 and 105 were dug immediately adjacent to the foundation of the existing building.

The soils found in test pits 101-103 were all marine lacustrine soils. Ledge was encountered at 63 inches in test pit 103. Test pits 101 and 102 were dug to 10 feet. Water was observed in test pit 101 at 72 inches and in test pit 103 at 40 inches. The water entering test pit 1 flowed at approximately 1-2 gallons per minute while the water in test pit 103 was just seepage. No water was observed in any of the other 3 test pits. The marine lacustrine soil material in all test pits appeared to be made up of cut and fill material, likely from the original time of construction onsite. There was little to no soil horizon development in most test pits. Only test pit 103 showed minimal signs of soil horizon development. Test pits 104 and 105 were dug adjacent to the building foundation. Both test pits showed 3-4 feet of marine lacustrine backfill material over 2-6 inch diameter rounded rock down to the top of the footer of the foundation which was located at 96 inches.

Test pit log descriptions are attached.

If you have any questions or require additional information, please contact me.

Sincerely,

A handwritten signature in black ink, appearing to read 'Mark J. Hampton', written over the printed name.

Mark J. Hampton L.S.E., C.S.S.

Licensed Site Evaluator #263

Certified Soil Scientist #216

Enc.

## SOIL PROFILE / CLASSIFICATION INFORMATION

SOIL SCIENTIST DESCRIPTION  
OF SOIL CONDITIONS AT PROJECT SITES

Project Name: MDIFW Building

Applicant Name: R. W. Gillespie &amp; Associates

Project Location (municipality): Augusta

Exploration Symbol # TP-101 ☒ Test Pit ☐ Boring ☐ Probe

" Organic horizon thickness Ground surface elev. \_\_\_\_\_

120 " Depth: ☒ of exploration, or ☐ to refusal

Horizon	Color	Texture	Structure	Consistence	Redox
0					
10					
20	Olive Gray	Sandy Clay Loam	Weak Sub Ang Blocky	Firm	
30					
40					
50	Olive	Silty Clay Loam	Blocky Prismatic	Firm	
60					
70					
80					
90					
100					
110					
120					
130					
140					
150					

Depth below mineral soil horizon (inches)

Water at 72 inches at 1-2 gpm

Limit of Excavation 120 inches

Soil  
Details

Soil Series/Phase Name:		Limiting Factor <input type="checkbox"/> Groundwater <input type="checkbox"/> Restrictive Layer <input type="checkbox"/> Bedrock	
Drainage Class <input type="checkbox"/> ED <input type="checkbox"/> SED <input type="checkbox"/> WD <input type="checkbox"/> MWD <input type="checkbox"/> SPD <input type="checkbox"/> PD <input type="checkbox"/> VPD		Slope 3 Percent	Hydric Soil <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes
		Hydrologic D Soil Group	

Exploration Symbol # TP-102 ☒ Test Pit ☐ Boring ☐ Probe

" Organic horizon thickness Ground surface elev. \_\_\_\_\_

120 " Depth: ☒ of exploration, or ☐ to refusal

Horizon	Color	Texture	Structure	Consistence	Redox
0	Dark Brown	Gravelly Sandy Loam	Fine granular	Friable	
10					
20	Olive Brown	Sandy Clay Loam	Weak Sub Ang Blocky	Firm	
30					
40					
50					
60					
70					
80					
90	Olive	Silty Clay Loam	Blocky	Firm	
100					
110					
120					
130					
140					
150					

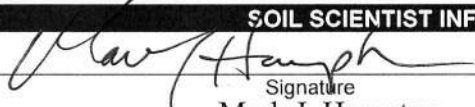
Depth below mineral soil horizon (inches)

Limit of Excavation 120 inches

Soil  
Details

Soil Series/Phase Name:		Limiting Factor <input type="checkbox"/> Groundwater <input type="checkbox"/> Restrictive Layer <input type="checkbox"/> Bedrock	
Drainage Class <input type="checkbox"/> ED <input type="checkbox"/> SED <input type="checkbox"/> WD <input type="checkbox"/> MWD <input type="checkbox"/> SPD <input type="checkbox"/> PD <input type="checkbox"/> VPD		Slope 3 Percent	Hydric Soil <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes
		Hydrologic D Soil Group	

## SOIL SCIENTIST INFORMATION AND SIGNATURE


Signature  
Mark J. Hampton

Name Printed

12/14/2023

Date

216

SS License No.

affix professional seal



## SOIL PROFILE / CLASSIFICATION INFORMATION

SOIL SCIENTIST DESCRIPTION  
OF SOIL CONDITIONS AT PROJECT SITES

Project Name: MDIFW Building

Applicant Name: R. W. Gillespie &amp; Associates

Project Location (municipality): Augusta

Exploration Symbol # TP-103 ☒ Test Pit ☐ Boring ☐ Probe

" Organic horizon thickness Ground surface elev. \_\_\_\_\_

63 " Depth: ☐ of exploration, or ☒ to refusal

Horizon	Color	Texture	Structure	Consistence	Redox
0					
10					
20	Olive Gray	Sandy Clay Loam	Weak Sub Ang Blocky	Firm	
30					
40					
50	Olive	Silty Clay Loam	Blocky Prismatic	Firm	Water Seepage at 40 inches
60					
70					
80					
90					
100					
110					
120					
130					
140					
150					

Depth below mineral soil horizon (inches)

LEDGE

Limit of Excavation 63 inches

Soil Series/Phase Name:

Limiting Factor

- ☐
- Groundwater
- 
- ☐
- Restrictive Layer
- 
- ☐
- Bedrock

Depth

Drainage Class

- ☐
- ED
- ☐
- SED
- ☐
- WD
- ☐
- MWD
- 
- ☐
- SPD
- ☐
- PD
- ☐
- VPD

Slope

3  
Percent

Hydric Soil

- ☒
- No
- 
- ☐
- Yes

Hydrologic

D  
Soil GroupSoil  
DetailsExploration Symbol # TP-104 ☒ Test Pit ☐ Boring ☐ Probe

" Organic horizon thickness Ground surface elev. \_\_\_\_\_

96 " Depth: ☒ of exploration, or ☐ to refusal

Horizon	Color	Texture	Structure	Consistence	Redox
0					
10					
20					
30					
40					
50					
60					
70					
80					
90					
100					
110					
120					
130					
140					
150					

Depth below mineral soil horizon (inches)

Olive Brown

Sandy Clay Loam

Weak Sub Ang Blocky

Firm

Brown

Rounded Rock

Loose

Top of footer found at 96 inches

Soil Series/Phase Name:

Limiting Factor

- ☐
- Groundwater
- 
- ☐
- Restrictive Layer
- 
- ☐
- Bedrock

Depth

Drainage Class

- ☐
- ED
- ☐
- SED
- ☐
- WD
- ☐
- MWD
- 
- ☐
- SPD
- ☐
- PD
- ☐
- VPD

Slope

3  
Percent

Hydric Soil

- ☒
- No
- 
- ☐
- Yes

Hydrologic

D  
Soil GroupSoil  
Details

## SOIL SCIENTIST INFORMATION AND SIGNATURE

Signature

Mark J. Hampton

Name Printed

12/14/2023

Date

216

SS License No.

affix professional seal



## SOIL PROFILE / CLASSIFICATION INFORMATION

SOIL SCIENTIST DESCRIPTION  
OF SOIL CONDITIONS AT PROJECT SITES

Project Name: MDIFW Building

Applicant Name: R. W. Gillespie &amp; Associates

Project Location (municipality): Augusta

Exploration Symbol # TP-105 ☒ Test Pit ☐ Boring ☐ Probe  
" Organic horizon thickness Ground surface elev. \_\_\_\_\_  
96 " Depth: ☐ of exploration, or ☒ to refusal

Horizon	Color	Texture	Structure	Consistence	Redox
0					
10					
20	Olive Brown	Sandy Clay Loam	Weak Sub Ang Blocky	Firm	
30					
40					
50					
60	Brown	Rounded Rock		Loose	
70					
80					
90					
100					
110					
120					
130					
140					
150					

Depth below mineral soil horizon (inches)

Top of footer found at 96 inches

Soil  
Details

Soil Series/Phase Name:		Limiting Factor <input type="checkbox"/> Groundwater <input type="checkbox"/> Restrictive Layer <input type="checkbox"/> Bedrock	
Drainage Class	Slope	Hydric Soil	Hydrologic
<input type="checkbox"/> ED <input type="checkbox"/> SED <input type="checkbox"/> WD <input type="checkbox"/> MWD <input type="checkbox"/> SPD <input type="checkbox"/> PD <input type="checkbox"/> VPD	<u>3</u> Percent	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes	Soil Group

Exploration Symbol # \_\_\_\_\_ ☐ Test Pit ☐ Boring ☐ Probe  
" Organic horizon thickness Ground surface elev. \_\_\_\_\_  
" Depth: ☐ of exploration, or ☐ to refusal

Horizon	Color	Texture	Structure	Consistence	Redox
0					
10					
20					
30					
40					
50					
60					
70					
80					
90					
100					
110					
120					
130					
140					
150					

Depth below mineral soil horizon (inches)

Soil  
Details

Soil Series/Phase Name:		Limiting Factor <input type="checkbox"/> Groundwater <input type="checkbox"/> Restrictive Layer <input type="checkbox"/> Bedrock	
Drainage Class	Slope	Hydric Soil	Hydrologic
<input type="checkbox"/> ED <input type="checkbox"/> SED <input type="checkbox"/> WD <input type="checkbox"/> MWD <input type="checkbox"/> SPD <input type="checkbox"/> PD <input type="checkbox"/> VPD	Percent	<input type="checkbox"/> No <input type="checkbox"/> Yes	Soil Group

## SOIL SCIENTIST INFORMATION AND SIGNATURE

Signature

Mark J. Hampton

Name Printed

12/14/2023

Date

216

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**APPENDIX E**

**LOGS OF PREVIOUSLY PREPARED RWG&A SUBSURFACE INFORMATION**

Geotechnical Engineering Evaluation  
Proposed Maine Department of Inland Fisheries & Wildlife Headquarters  
Augusta, Maine

RWG&A, Inc. soil descriptions are based on the following criteria. Descriptive terminology is used to denote the grain size and percentage of each component. The soil descriptions are based on visual-manual classification procedures, Standard Penetration Test results, and the results of laboratory testing on selected soil samples, where available. The Unified Soil Classification Group Symbol will be indicated in capital letters.

#### COMPONENT DEFINITIONS BY GRADATION SIEVE LIMITS

Materials	Definitions	Fractions	Upper	Lower
Boulders	Material too large to pass through an opening 12 in. square.			
Cobbles	Material passing through a 12 in. opening and retained on the 3 in. sieve.			
Gravel	Material passing the 3 in. sieve and retained on 1/4" (No. 4 sieve).	Coarse Fine	3 in. 3/4 in.	3/4 in. 1/4 in.
Sand	Material passing the No. 4 sieve and retained on the No. 200 sieve.	Coarse Medium Fine	No. 4 (1/4") No. 10 (1/8") No. 40 (1/32")	No. 10 (1/8") No. 40 (1/32") No. 200
Silt	Material passing the No. 200 sieve which is usually non-plastic in character and exhibits little or no strength when air dried.		No. 200	
Clay	Material passing the No. 200 sieve which can also be made to exhibit plasticity within a certain range of moisture contents and which exhibits considerable strength when air dried.		No. 200	

#### SOIL DESCRIPTION

##### General

Soils are described as to the Unified Soil Classification Systems Group Symbol, density or consistency, color, grain size distribution and other pertinent properties such as plasticity and dry strength. The RWG&A order of descriptors is as follows:

1. USCS Group Name and Symbol, or Fill
2. Density or Consistency
3. Moisture
4. Grain Size & Constituent percentages
5. Other pertinent descriptors
6. Color

#### DESCRIPTIVE TERMINOLOGY DENOTING COMPONENT PROPORTIONS

<u>Descriptive Terms</u>	<u>Range of Proportions</u>
Noun (major component)	≥50%
Adjective (secondary component)	20 - 50%
Some (third component)	25 - 45%
Little (second or third component)	15 - 25%
Few (second or third component)	5 - 15%
Trace	0 - 5%
With	Amount of component not determined. Used as a conjunction only. Does not indicate component percentile

#### OTHER DESCRIPTIVE TERMS

Where appropriate, geological classifications are also used (Glacial Till, etc.)

#### TYPICAL DESCRIPTIONS

SAND WITH SILT (SP-SM): Medium dense, moist, coarse to medium sand, few silt, brown.

FILL; Loose, dry, fine sand, some gravel and silt, with brick and concrete fragments, dark brown.

SILTY CLAY (CL); Very stiff, moist, silty clay, olive-brown.

<u>DENSITY OR CONSISTENCY OF SOILS</u>		
<u>COHESIVE SOILS</u>		
<u>Consistency of Cohesive Soils</u>	<u>Standard Penetration Test (Blows Per Foot) (N)</u>	<u>Undrained Shear Strength (TSF)</u>
Very Soft	0 - 2	Below 0.13 (250 psf)
Soft	2 - 4	0.13 to 0.25 (to 500 psf)
Medium	4 - 8	0.25 to 0.5 (to 1,000 psf)
Stiff	8 - 15	0.5 to 1.0 (to 2,000 psf)
Very Stiff	15 - 30	1.0 to 2.0 (to 4,000 psf)
Hard	Over 30	over 2.0 (over 4,000 psf)
Consistency of cohesive soils is based upon field vane shear, torvane, or pocket penetrometer, or laboratory vane shear or Unconsolidated-Undrained Triaxial Compression tests. Consistency of cohesive soils is based upon the Standard Penetration test when no other data is available.		
<u>COHESIONLESS SOILS</u>		
<u>Density of Cohesionless Soils</u>	<u>Standard Penetration Test (Blows per Foot) (in)</u>	
Very Loose	0 - 4	
Loose	4 - 10	
Medium Dense	10 - 30	
Dense	30 - 50	
Very Dense	over 50	
<u>PENETRATION RESISTANCE</u>		
STANDARD PENETRATION TEST (ASTM D1586) - a 2.0-inch diameter, 1-3/8 inch inside diameter split barrel sample is driven into soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The total number of blows required for penetration from 6 to 18 inches is the Standard Penetration Resistance (N).		
<u>COBBLES AND BOULDERS</u>		
The percentage of cobbles and boulders is estimated visually where possible.		
<u>Descriptive Term</u>	<u>Estimated Percentage</u>	
Very Few	0 - 10%	
Few	10 - 25%	
Common	25 - 40%	
Numerous	40 - 50%	
If the percentage cannot be determined, as in a typical test boring, then use “with” to indicate the presence of cobbles and/or boulders. (i.e., gravelly sand with cobbles and boulders).		
<u>FILLS</u>		
The following terminology is used to denote size range of man-made materials within fill deposits:		
<u>Size Range</u>	<u>Comparative Soil Terms</u>	
<No. 200 Sieve	Silt - size	
No. 200 to 1/4 in.	Sand - size	
1/4 in. to 3 in.	Gravel - size	
3 in. to 12 in.	Cobble - size	
>12 in.	Boulder - size	
<u>SUPPLEMENTAL SOIL DESCRIPTION TERMINOLOGY</u>		
<u>Term</u>	<u>Example</u>	
Seam	Typically 1/16 to 1/2 inch thick	1/4 inch sand seams
Layer	Greater than 1/2 inch thick	2-inch sand layers
Occasional	One or less per foot of thickness	
Frequent	More than one per foot of thickness	
Interbedded	Alternating soil layers of different composition	
Varved	Alternating thin seams of silt and clay	
Mottled	Variations in color	



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-1

Total Depth (ft): 30.5

Sheet 1 of 2

Project Name: MDIF&W Headquarters

RWG&A Project No. 0767-159

Location: Augusta, Maine

Client: Oak Point Associates

RWG&A Representative: Tom Snow

Boring Location: See Exploration Location Plan

Boring Abandonment Method: Backfill with cutting

Observed Water Depth: 9'

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50 Small Rubber Track

Driller Rep.: Mike Nadeau

Date Started: 09/23/2022

Date Completed: 09/23/2022

Surface Elevation:

Drilling Method: 2 1/4" HSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0		S-1	FILL; TOPSOIL AND ORGANIC MATERIAL (6 inches).	10	3 4 7 7			
			FILL; Sand with silt and gravel, coarse to fine sand, little gravel, few silt, slag coal fragments, dark gray to black.					
			SANDY SILT WITH CLAY (ML); Loose to medium dense, moist, silt, little clay, some medium to fine sand, mottled, light brown to gray					
5		S-2	Medium dense.	18	6 7 10 10	17	24.9	MC GS
10		S-3	Loose, wet, few fine sand.	17	2 2 2 3	4		
15		S-4	Soft, gray.	20	2 2 2 2	4		
20		S-5		20	2 2 2 2	4		
25		S-6	Push rod probe to refusal surface.	20	1 2 1 2	3		
30								

Notes: Reported SPT hammer energy transfer ratio is 93 percent. SPT N-values are uncorrected for energy transfer.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-1

Total Depth: 30.5

Sheet 2 of 2

Project Name: MDIF&W Headquarters

Location: Augusta Maine

Client: Oak Point Associates

Observed Water Depth: 9'

RWG&A Project No. 0767-159

Surface Elevation:

Casing Type: N/A

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
30			Denser. Bottom of Exploration at 30.5'; Rod probe refusal on firm stratum.					
35								
40								
45								
50								
55								
60								

Notes: Reported SPT hammer energy transfer ratio is 93 percent. SPT N-values are uncorrected for energy transfer.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-2

Total Depth (ft): 33

Sheet 1 of 2

Project Name: MDIF&W Headquarters

RWG&A Project No. 0767-159

Location: Augusta, Maine

Client: Oak Point Associates

RWG&A Representative: Tom Snow

Boring Location: See Exploration Location Plan

Boring Abandonment Method: Backfill with cutting

Observed Water Depth: 9'

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50 Small Rubber Track

Driller Rep.: Mike Nadeau

Date Started: 09/23/2022

Date Completed: 09/23/2022

Surface Elevation:

Drilling Method: 2 1/4" HSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0		S-1	FILL; Sand with gravel and silt, cobbles and boulders.	0	3 4 14 15			
5		S-2	SILT WITH SAND (ML); Loose to medium dense, dry, silt, some fine sand, light brown.  Medium dense.	18	7 8 11 16	19		
10		S-3	Loose, wet, few fine sand.	20	5 3 2 2	5		
15		S-4	CLAYEY SILT (ML); Very loose to loose, wet, silt, some clay, few fine sand, olive.	20	1 2 2 2	4		
20		S-5	Push probe rod to refusal surface.  Denser.		1 1 2 1	3		
30								

Notes: Reported SPT hammer energy transfer ratio is 93 percent. SPT N-values are uncorrected for energy transfer.



Boring Log: B-2

Total Depth: 33

Sheet 2 of 2

Project Name: MDIF&amp;W Headquarters

Location: Augusta Maine

Client: Oak Point Associates

Observed Water Depth: 9'

RWG&amp;A Project No. 0767-159

Surface Elevation:

Casing Type: N/A

[illegible]

Notes: Reported SPT hammer energy transfer ratio is 93 percent. SPT N-values are uncorrected for energy transfer.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-4

Total Depth (ft): 7.3

Sheet 1 of 1

Project Name: MDIF&W Headquarters

RWG&A Project No. 0767-159

Location: Augusta, Maine

Client: Oak Point Associates

RWG&A Representative: Tom Snow

Boring Location: See Exploration Location Plan

Boring Abandonment Method: Backfill with cutting

Observed Water Depth:

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50 Small Rubber Track

Driller Rep.: Mike Nadeau

Date Started: 09/23/2022

Date Completed: 09/23/2022

Surface Elevation:

Drilling Method: 2 1/4" HSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANIC MATERIAL (4 inches). SILT WITH SAND (ML); Very loose to medium dense, moist, silt, some medium to fine sand, trace gravel, light brown.	14	1 1 3 3	4		
5		S-2	Medium dense.	15	4 5 6 6	11		
			Bottom of Exploration at 7.3'; Auger refusal on possible bedrock.					
10								
15								
20								
25								
30								

Notes: Reported SPT hammer energy transfer ratio is 93 percent. SPT N-values are uncorrected for energy transfer.





**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-5

Total Depth (ft): 23.3

Sheet 1 of 1

Project Name: MDIF&W Headquarters

RWG&A Project No. 0767-159

Location: Augusta, Maine

Client: Oak Point Associates

RWG&A Representative: Tom Snow

Boring Location: See Exploration Location Plan

Boring Abandonment Method: Backfill with cutting

Observed Water Depth: 14'

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50 Small Rubber Track

Driller Rep.: Mike Nadeau

Date Started: 09/23/2022

Date Completed: 09/23/2022

Surface Elevation:

Drilling Method: 2 1/4" HSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANIC MATERIAL (6 inches). SILT WITH SAND (ML); Very loose to medium dense, dry, silt, little fine sand, light brown to gray.	7	1 1 2 3	3		
5		S-2	Medium dense.	20	5 7 9 9	16		
10		S-3	Loose, wet, few fine sand.	20	4 3 3 2	6		
15		S-4	Very loose, trace gravel.	20	1 2 1 2	3		
20		S-5		20	2 2 4 6	6		
			SILTY SAND (SM); Loose to medium dense, wet, coarse to fine sand, little silt, light brown to gray.					
			Bottom of Exploration at 23.3'; Auger refusal on possible bedrock.					
25								
30								

Notes: Reported SPT hammer energy transfer ratio is 93 percent. SPT N-values are uncorrected for energy transfer.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-7

Total Depth (ft): 3.8

Sheet 1 of 1

Project Name: MDIF&W Headquarters

RWG&A Project No. 0767-159

Location: Augusta, Maine

Client: Oak Point Associates

RWG&A Representative: Tom Snow

Boring Location: See Exploration Location Plan

Boring Abandonment Method: Backfill with cutting

Observed Water Depth:

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50 Small Rubber Track

Driller Rep.: Mike Nadeau

Date Started: 09/23/2022

Date Completed: 09/23/2022

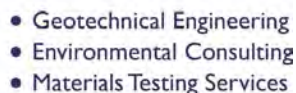
Surface Elevation:

Drilling Method: 2 1/4" HSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANIC MATERIAL (4 inches). SILTY SAND (SM); Very loose, moist, medium to fine sand, some silt, light brown.	10	2 2 2 2	4		
5			Bottom of Exploration at 3.8'; Auger refusal on possible bedrock.					
10								
15								
20								
25								
30								

Notes: Reported SPT hammer energy transfer ratio is 93 percent. SPT N-values are uncorrected for energy transfer.



Sheet 1 of 1

Drilling Co.: Northern Test Boring
Drill Rig: Diedrich D-50 Small Rubber Track
Driller Rep.: Mike Nadeau
Date Started: 09/22/2022
Date Completed: 09/22/2022
Surface Elevation:
Drilling Method: 2 1/4" HSA
Casing Type: N/A

Notes: Reported SPT hammer energy transfer ratio is 93 percent. SPT N-values are uncorrected for energy transfer.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-13

Total Depth (ft): 17.4

Sheet 1 of 1

Project Name: MDIF&W Headquarters

RWG&A Project No. 0767-159

Location: Augusta, Maine

Client: Oak Point Associates

RWG&A Representative: Tom Snow

Boring Location: See Exploration Location Plan

Boring Abandonment Method: Backfill with cutting

Observed Water Depth:

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50 Small Rubber Track

Driller Rep.: Mike Nadeau

Date Started: 09/23/2022

Date Completed: 09/23/2022

Surface Elevation:

Drilling Method: 2 1/4" HSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0		S-1	ASPHALTIC PAVEMENT (2 inches).	10	6 12 7 6			
			FILL; Sand with silt and gravel, moist, coarse to fine sand, little silt, little to some gravel, brown.					
			CLAYEY SILT WITH SAND (ML); Loose, moist, silt, little clay, little fine sand, gray, few orange-brown oxidation seams.					
5		S-2		20	3 4 4 7	8		
10		S-3		20	2 2 2 2	4		
15		S-4		20	2 2 21 19	23		
			SILTY SAND WITH GRAVEL (SM); Medium dense to dense, coarse to fine sand, little silt, little gravel, light brown to gray.					
			Bottom of Exploration at 17.4'; Auger refusal on possible bedrock.					
20								
25								
30								

Notes: Reported SPT hammer energy transfer ratio is 93 percent. SPT N-values are uncorrected for energy transfer.



**R.W. Gillespie  
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-14

Total Depth (ft): 5.6

Sheet 1 of 1

Project Name: MDIF&W Headquarters

RWG&A Project No. 0767-159

Location: Augusta, Maine

Client: Oak Point Associates

RWG&A Representative: Tom Snow

Boring Location: See Exploration Location Plan

Boring Abandonment Method: Backfill with cutting

Observed Water Depth: Not Obs.

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50 Small Rubber Track

Driller Rep.: Mike Nadeau

Date Started: 09/23/2022

Date Completed: 09/23/2022

Surface Elevation:

Drilling Method: 2 1/4" HSA

Casing Type: N/A

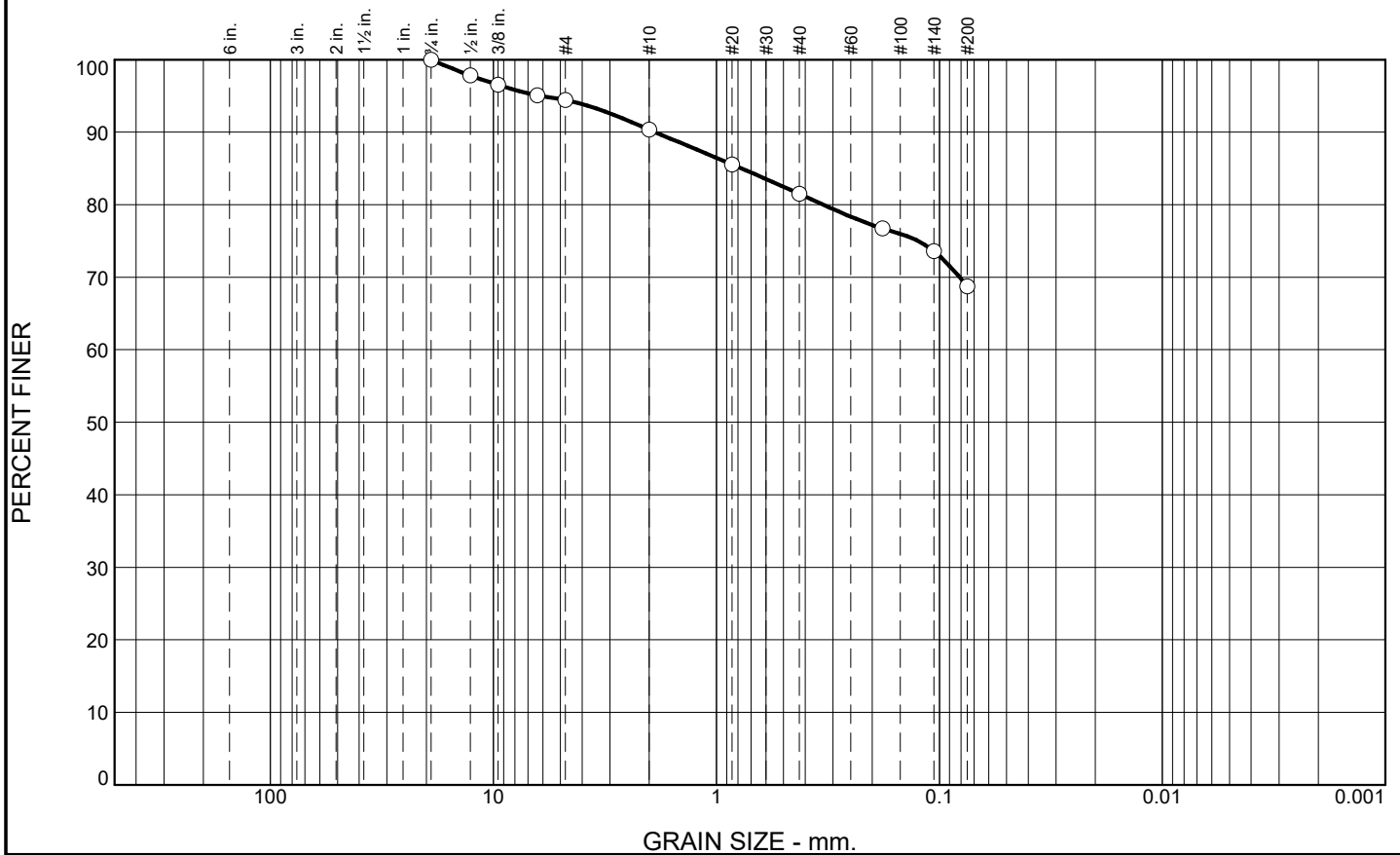
DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0		S-1	FILL; TOPSOIL AND ORGANIC MATERIAL (5 inches).	12	3	15		
			FILL; Sand, coarse to fine sand, moist, gray.		6			
			SILTY SAND WITH GRAVEL (SM); Medium dense, moist, coarse to fine sand, little silt, little gravel, light brown.		9			
			Cobble.		11			
5		S-2	Cobble.	5	50/5"			
			Bottom of Exploration at 5.6'; Auger refusal on possible bedrock.					
10								
15								
20								
25								
30								

Notes: Reported SPT hammer energy transfer ratio is 93 percent. SPT N-values are uncorrected for energy transfer.

**APPENDIX F**  
**LABORATORY TEST RESULTS**

Geotechnical Engineering Evaluation  
Proposed Maine Department of Inland Fisheries & Wildlife Headquarters  
Augusta, Maine

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.6	4.1	8.8	12.7	68.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	97.8		
3/8"	96.5		
1/4"	95.1		
#4	94.4		
#10	90.3		
#20	85.5		
#40	81.5		
#80	76.7		
#140	73.6		
#200	68.8		

\* (no specification provided)

**Soil Description**  
sandy silt

**Atterberg Limits**  
 PL=      LL=      PI=

**Coefficients**  
 D<sub>90</sub>= 1.8840      D<sub>85</sub>= 0.7724      D<sub>60</sub>=  
 D<sub>50</sub>=      D<sub>30</sub>=      D<sub>15</sub>=  
 D<sub>10</sub>=      C<sub>u</sub>=      C<sub>c</sub>=

**Classification**  
 USCS= ML      AASHTO= A-4(0)

**Remarks**  
 Moisture Content: 19.4%

Location: B-105  
 Sample Number: S-2      Depth: 2-4'

Date: 12/21/2023

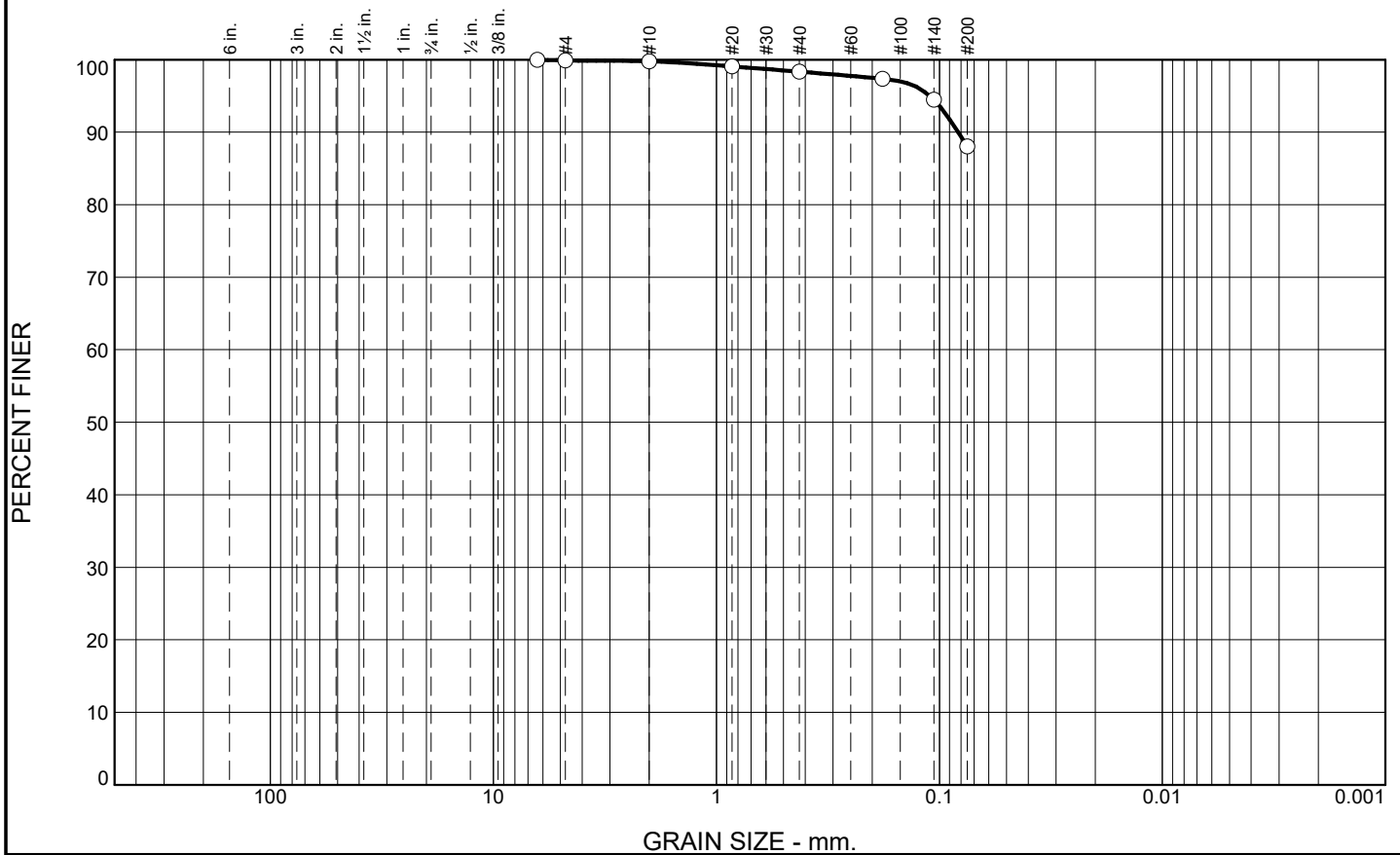
**R.W. Gillespie  
 & Associates, Inc.  
 Biddeford, Maine**

**Client:** Oak Point Associates  
**Project:** Proposed Maine Dept of Inland Fisheries & Wildlife HQ  
 Augusta, ME  
**Project No:** 0767-166      **Lab No.** 17815-01

Tested By: CAG/SJV      Checked By: MTG

MTG

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.1	1.5	10.3	88.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	99.9		
#10	99.8		
#20	99.1		
#40	98.3		
#80	97.4		
#140	94.5		
#200	88.0		

\* (no specification provided)

**Soil Description**  
silt

**Atterberg Limits**  
 PL=      LL=      PI=

**Coefficients**  
 D<sub>90</sub>= 0.0824      D<sub>85</sub>=      D<sub>60</sub>=  
 D<sub>50</sub>=      D<sub>30</sub>=      D<sub>15</sub>=  
 D<sub>10</sub>=      C<sub>u</sub>=      C<sub>c</sub>=

**Classification**  
 USCS= ML      AASHTO= A-4(0)

**Remarks**  
 Moisture Content: 25.9%

Location: B-106  
 Sample Number: S-2      Depth: 2-4'

Date: 12/21/2023

**R.W. Gillespie  
 & Associates, Inc.  
 Biddeford, Maine**

**Client:** Oak Point Associates  
**Project:** Proposed Maine Dept of Inland Fisheries & Wildlife HQ  
 Augusta, ME  
**Project No:** 0767-166

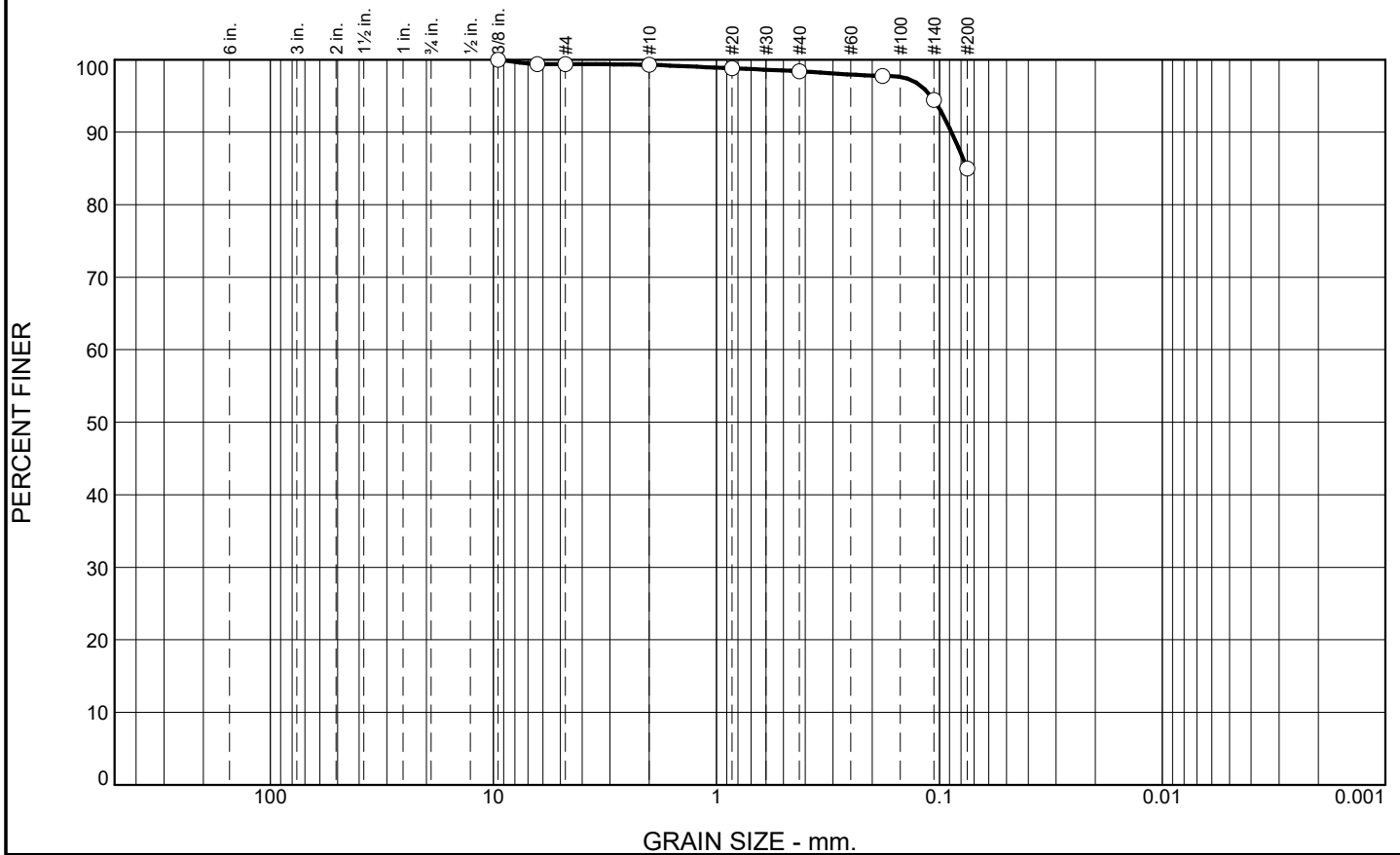
**Lab No.** 17815-02

Tested By: CAG/SJV      Checked By: MTG

MTG



# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.6	0.1	0.9	13.4	85.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100.0		
1/4"	99.4		
#4	99.4		
#10	99.3		
#20	98.8		
#40	98.4		
#80	97.8		
#140	94.5		
#200	85.0		

\* (no specification provided)

**Soil Description**  
silt with sand

**Atterberg Limits**  
PL=      LL=      PI=

**Coefficients**  
D<sub>90</sub>= 0.0883      D<sub>85</sub>= 0.0750      D<sub>60</sub>=  
D<sub>50</sub>=      D<sub>30</sub>=      D<sub>15</sub>=  
D<sub>10</sub>=      C<sub>u</sub>=      C<sub>c</sub>=

**Classification**  
USCS= ML      AASHTO= A-4(0)

**Remarks**  
Moisture Content: 27.0%

Location: B-107  
Sample Number: S-3      Depth: 5-7'

Date: 12/21/2023

**R.W. Gillespie  
& Associates, Inc.  
Biddeford, Maine**

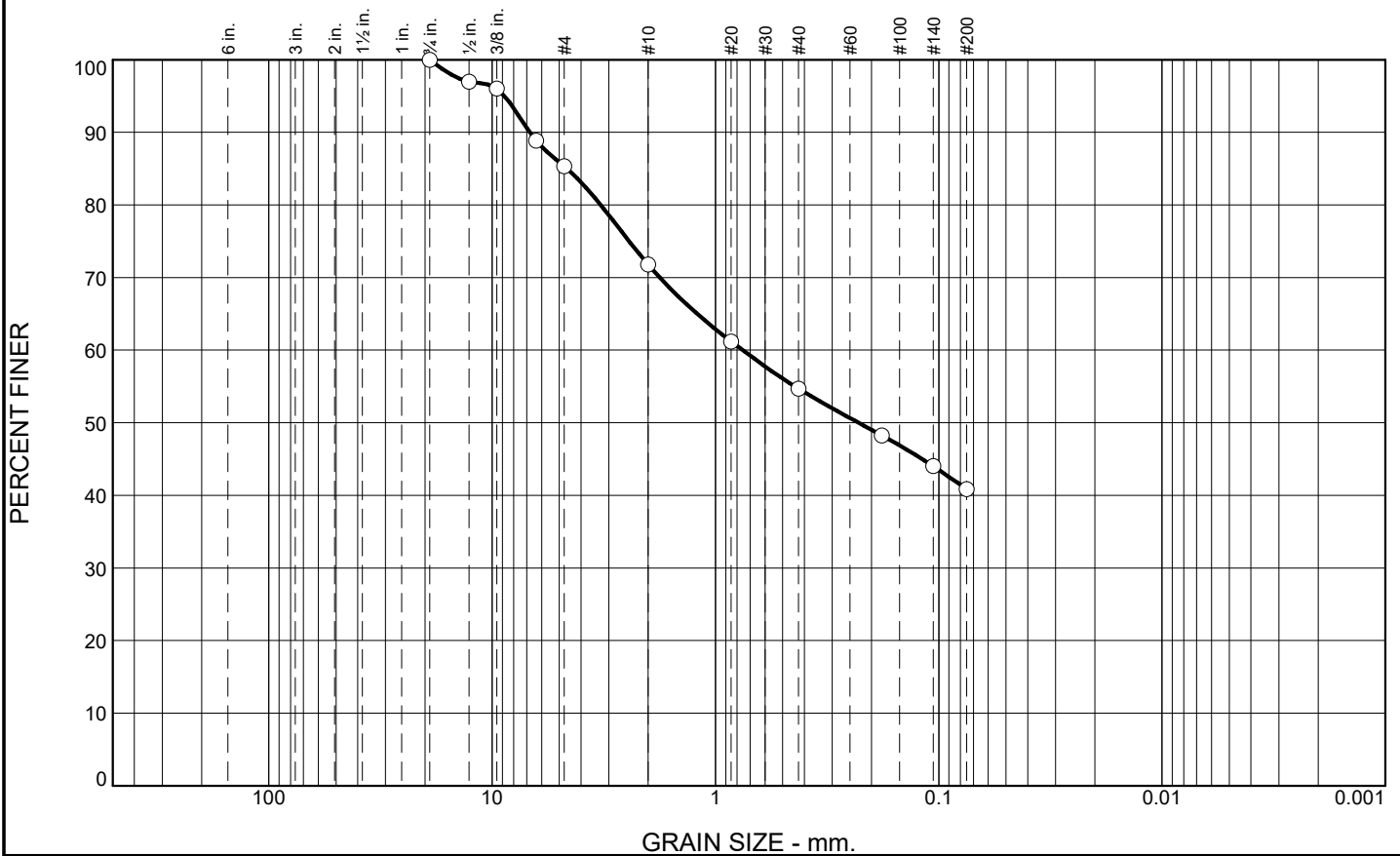
**Client:** Oak Point Associates  
**Project:** Proposed Maine Dept of Inland Fisheries & Wildlife HQ  
Augusta, ME  
**Project No:** 0767-166

**Lab No.** 17815-03

Tested By: CAG/SJV      Checked By: MTG

MTG

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	14.7	13.5	17.1	13.9	40.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	97.0		
3/8"	96.0		
1/4"	88.8		
#4	85.3		
#10	71.8		
#20	61.2		
#40	54.7		
#80	48.3		
#140	44.0		
#200	40.8		

\* (no specification provided)

**Soil Description**  
 silty sand

**Atterberg Limits**  
 PL=      LL=      PI=

**Coefficients**  
 D<sub>90</sub>= 6.7821      D<sub>85</sub>= 4.6115      D<sub>60</sub>= 0.7554  
 D<sub>50</sub>= 0.2284      D<sub>30</sub>=      D<sub>15</sub>=  
 D<sub>10</sub>=      C<sub>u</sub>=      C<sub>c</sub>=

**Classification**  
 USCS= SM      AASHTO= A-4(0)

**Remarks**  
 Moisture Content: 14.5%

Location: B-110  
 Sample Number: S-1      Depth: 0.2-2'

Date: 12/21/2023

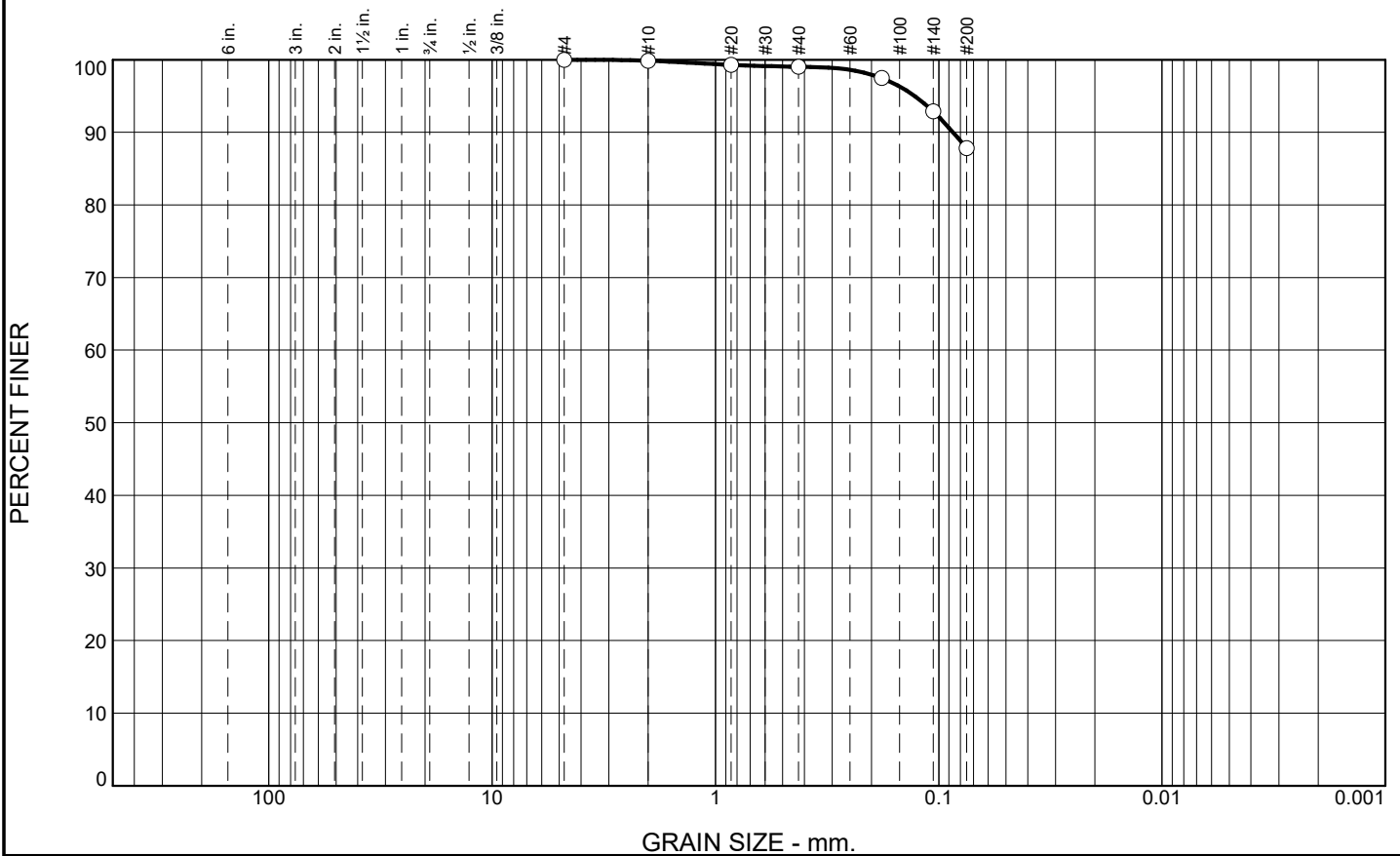
**R.W. Gillespie  
 & Associates, Inc.  
 Biddeford, Maine**

**Client:** Oak Point Associates  
**Project:** Proposed Maine Dept of Inland Fisheries & Wildlife HQ  
 Augusta, ME  
**Project No:** 0767-166      **Lab No.** 17815-04

Tested By: CAG/SSJV      Checked By: MTG

MTG

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.9	11.2	87.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.3		
#40	99.0		
#80	97.5		
#140	92.9		
#200	87.8		

\* (no specification provided)

**Soil Description**  
silt

**Atterberg Limits**  
 PL=      LL=      PI=

**Coefficients**  
 D<sub>90</sub>= 0.0864      D<sub>85</sub>=      D<sub>60</sub>=  
 D<sub>50</sub>=      D<sub>30</sub>=      D<sub>15</sub>=  
 D<sub>10</sub>=      C<sub>u</sub>=      C<sub>c</sub>=

**Classification**  
 USCS= ML      AASHTO= A-4(0)

**Remarks**  
 Moisture Content: 24.9%

Location: B-111  
 Sample Number: S-3      Depth: 4-6'

Date: 12/21/2023

**R.W. Gillespie  
 & Associates, Inc.  
 Biddeford, Maine**

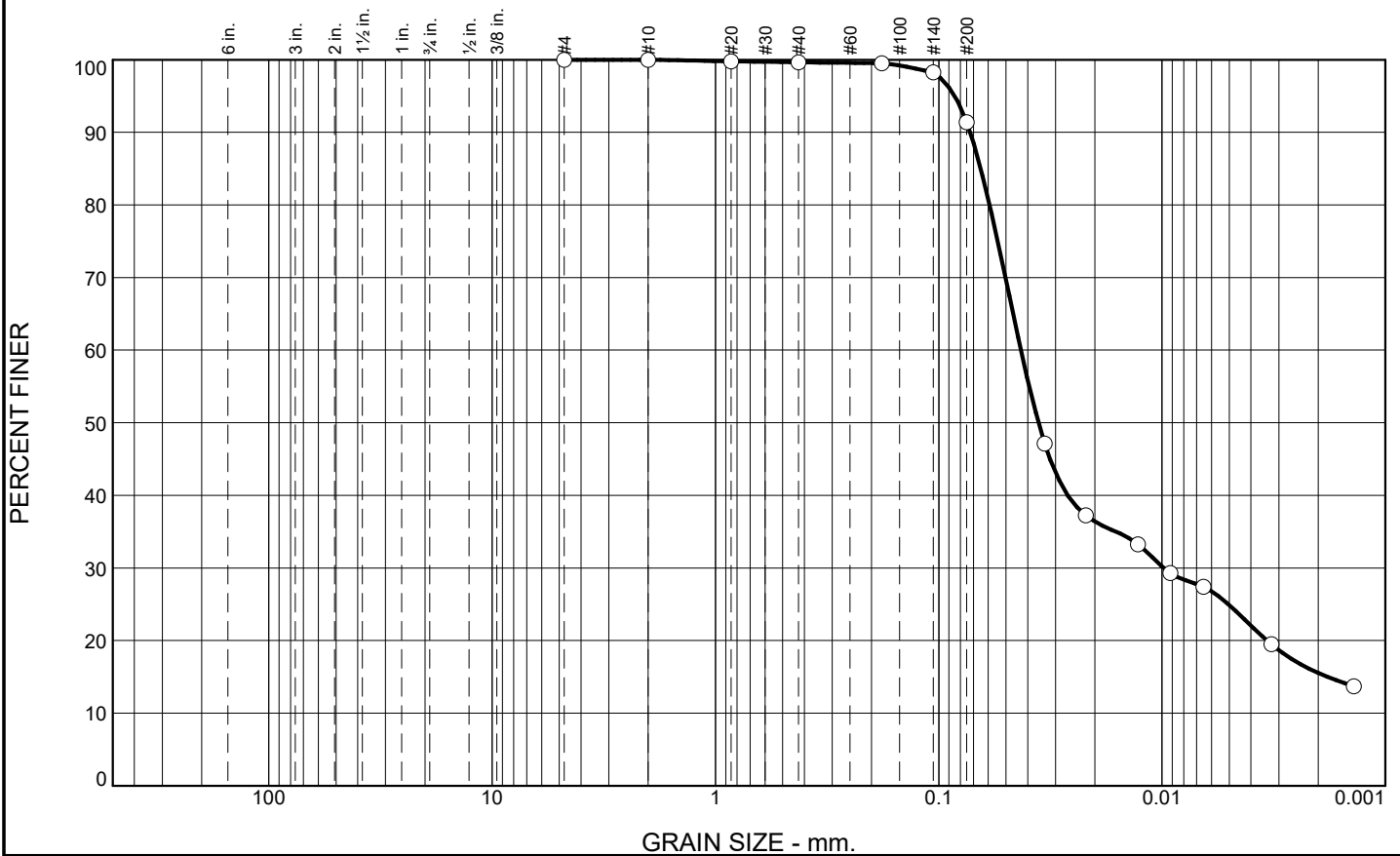
**Client:** Oak Point Associates  
**Project:** Proposed Maine Dept of Inland Fisheries & Wildlife HQ  
 Augusta, ME  
**Project No:** 0767-166

**Lab No.** 17815-05

Tested By: CAG/SJV      Checked By: MTG

MTG

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.4	8.2	75.8	15.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.8		
#40	99.6		
#80	99.5		
#140	98.2		
#200	91.4		
0.0335 mm.	47.1		
0.0219 mm.	37.2		
0.0128 mm.	33.3		
0.0092 mm.	29.3		
0.0065 mm.	27.4		
0.0032 mm.	19.5		
0.0014 mm.	13.7		

\* (no specification provided)

<b><u>Soil Description</u></b>		
silty clay		
<b><u>Atterberg Limits</u></b>		
PL= 16.2	LL= 21.2	PI= 5.0
<b><u>Coefficients</u></b>		
D <sub>90</sub> = 0.0723	D <sub>85</sub> = 0.0649	D <sub>60</sub> = 0.0428
D <sub>50</sub> = 0.0357	D <sub>30</sub> = 0.0098	D <sub>15</sub> = 0.0018
D <sub>10</sub> =	C <sub>u</sub> =	C <sub>c</sub> =
<b><u>Classification</u></b>		
USCS= CL-ML	AASHTO= A-4(2)	
<b><u>Remarks</u></b>		
Moisture Content: 27.7%		

Location: B-102A  
Sample Number: U-1

Depth: 19.5'

Date: 01/05/2024

**R.W. Gillespie  
& Associates, Inc.  
Biddeford, Maine**

**Client:** Oak Point Associates  
**Project:** Proposed Maine Dept of Inland Fisheries & Wildlife HQ  
Augusta, ME  
**Project No:** 0767-166

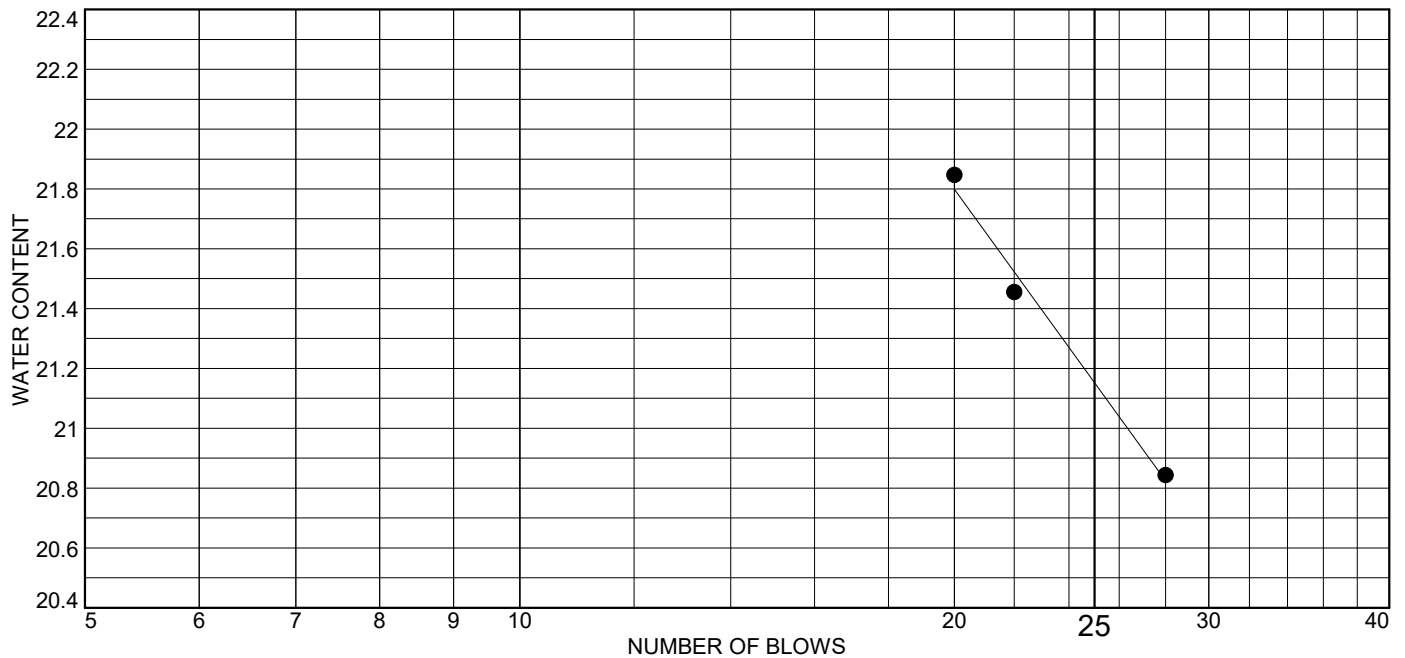
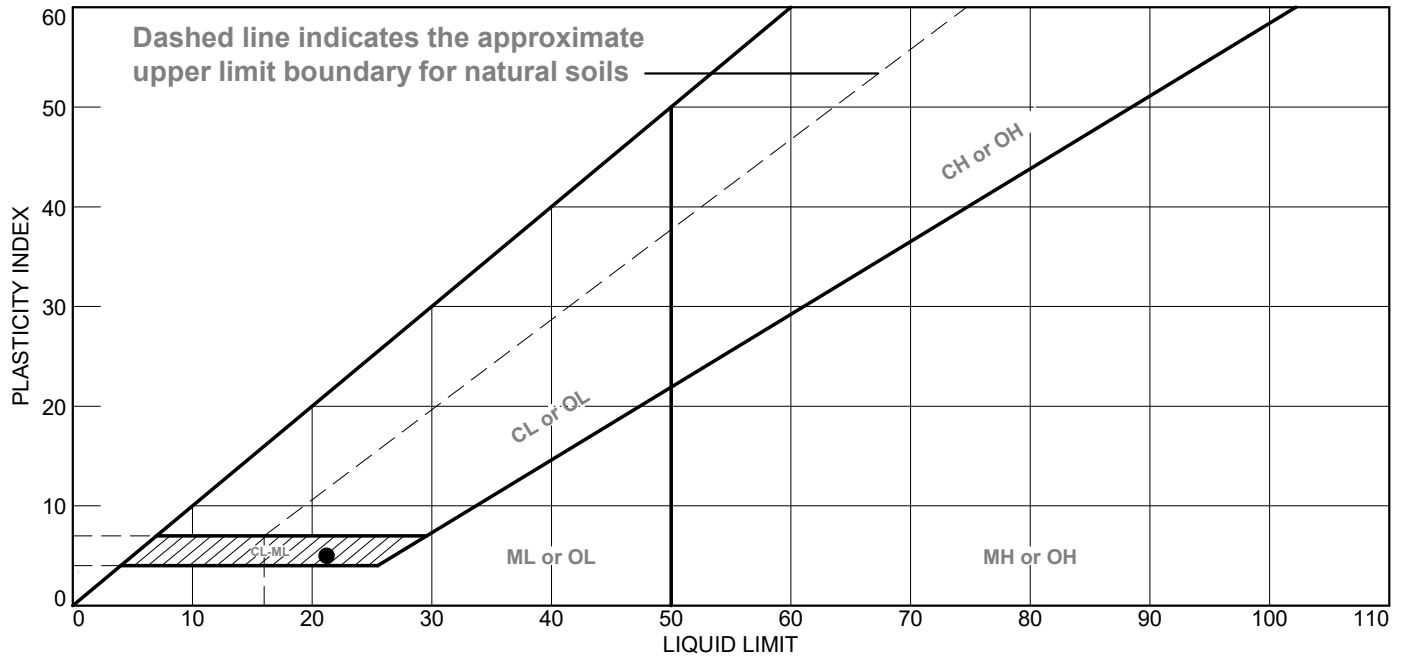
**Lab No.** 17816

Tested By: CAG/JMT

Checked By: MTG

MTG

# LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	silty clay	21.2	16.2	5.0	99.6	91.4	CL-ML

<b>Project No.</b> 0767-166 <b>Client:</b> Oak Point Associates <b>Project:</b> Proposed Maine Dept of Inland Fisheries & Wildlife HQ Augusta, ME <b>Location:</b> B-102A <b>Sample Number:</b> U-1 <b>Depth:</b> 19.5' <b>R.W. Gillespie &amp; Associates, Inc.</b> <b>Biddeford, Maine</b>	<b>Remarks:</b>          <b>Lab No.</b> 17816
--	---

Tested By: JMT      Checked By: MTG

MTG

## Laboratory Vane Shear Test Results

ASTM D4648 Standard Test Method for Laboratory Miniature Vane Shear Test for Saturated Fine-Grained Clayey Soil

Project: Proposed Maine Dep of Inland Fisheries & Location: Augusta, ME  
 Client: Oak Point Associates Date: 12/15/2023  
 Project No.: 0767-166 Test Depth: 19.00 to 19.60

Boring/Sample No.		B-102A			Lab No.	17816	
Test No.	Test Depth (ft)	Vane Size	Max. Torque (Undisturbed) (kg-cm)	Max. Torque (Remolded) (kg-cm)	Undrained Shear Strength (psf)	Undrained Shear Strength (psf)	Moisture Content
1	19	L	84	10	877	104	31%
2	19.3	L	85	13	887	136	36%
3	19.6	L	102	13	1065	136	28%

Vane Size	
	(mm)
S	16 x 32
M	20 x 40
L	24.5 x 50.8

Tested By: CAG

Checked By: MTG

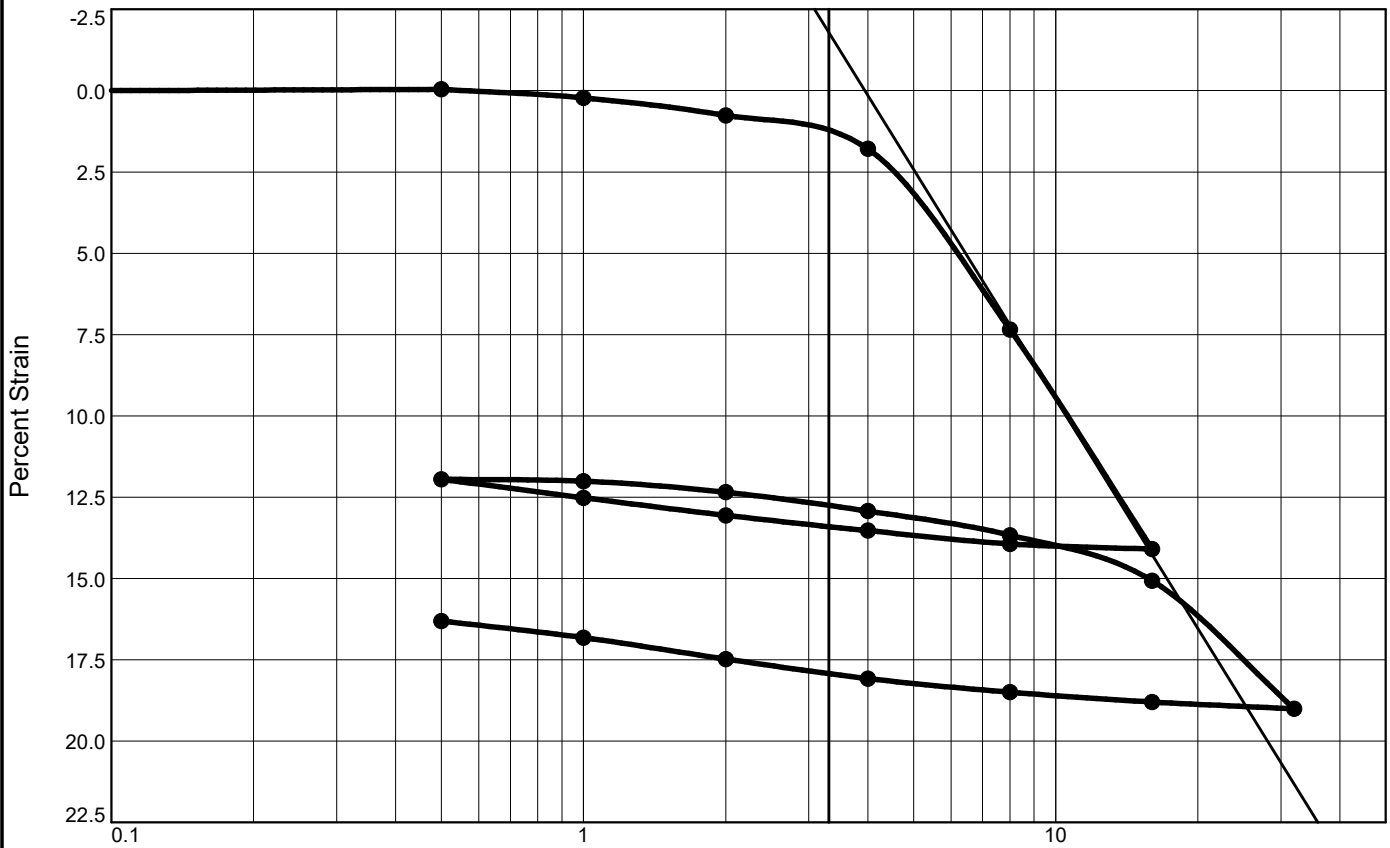


R.W. Gillespie & Associates

20 Pomerleau St., Suite 100, Biddeford ME 04005, 207-286-8008 / 177 Shattuck Way, Suite 1 West, Newington NH 03801, 603-427-0244

MTG

# CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (ksf)	$C_v$ (ft.2/day)	$C_\alpha$	No.	Load (ksf)	$C_v$ (ft.2/day)	$C_\alpha$	No.	Load (ksf)	$C_v$ (ft.2/day)	$C_\alpha$
1	0.50	1.142		8	4.00	0.845		15	8.00	0.656	
2	1.00	1.930		9	2.00	0.366		16	16.00	0.567	
3	2.00	1.834		10	1.00	0.141		17	32.00	0.204	
4	4.00	1.148		11	0.50	0.059		18	16.00	3.290	
5	8.00	0.106		12	1.00	0.493		19	8.00	0.939	
6	16.00	0.131		13	2.00	0.483		20	4.00	0.328	
7	8.00	1.981		14	4.00	0.360		21	2.00	0.159	

22 1.00  
23 0.50

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	$P_c$ (ksf)	$C_c$	$C_r$	Initial Void Ratio
Saturation	Moisture									
94.6 %	35.4 %	85.8	21.2	5.0	2.75	2.0	4.6	0.48	0.04	1.027

MATERIAL DESCRIPTION	USCS	AASHTO
silty clay	CL-ML	A-4(2)

<b>Project No.</b> 0767-166 <b>Project:</b> Proposed Maine Dept of Inland Fisheries & Wildlife HQ Augusta, ME <b>Location:</b> B-102A <b>Depth:</b> 19.5' <b>Sample Number:</b> U-1 <b>R.W. Gillespie &amp; Associates, Inc.</b> <b>Biddeford, Maine</b>	<b>Client:</b> Oak Point Associates <b>Remarks:</b> Seating Load 0.0021 <b>Lab No.</b> 17816
---	---

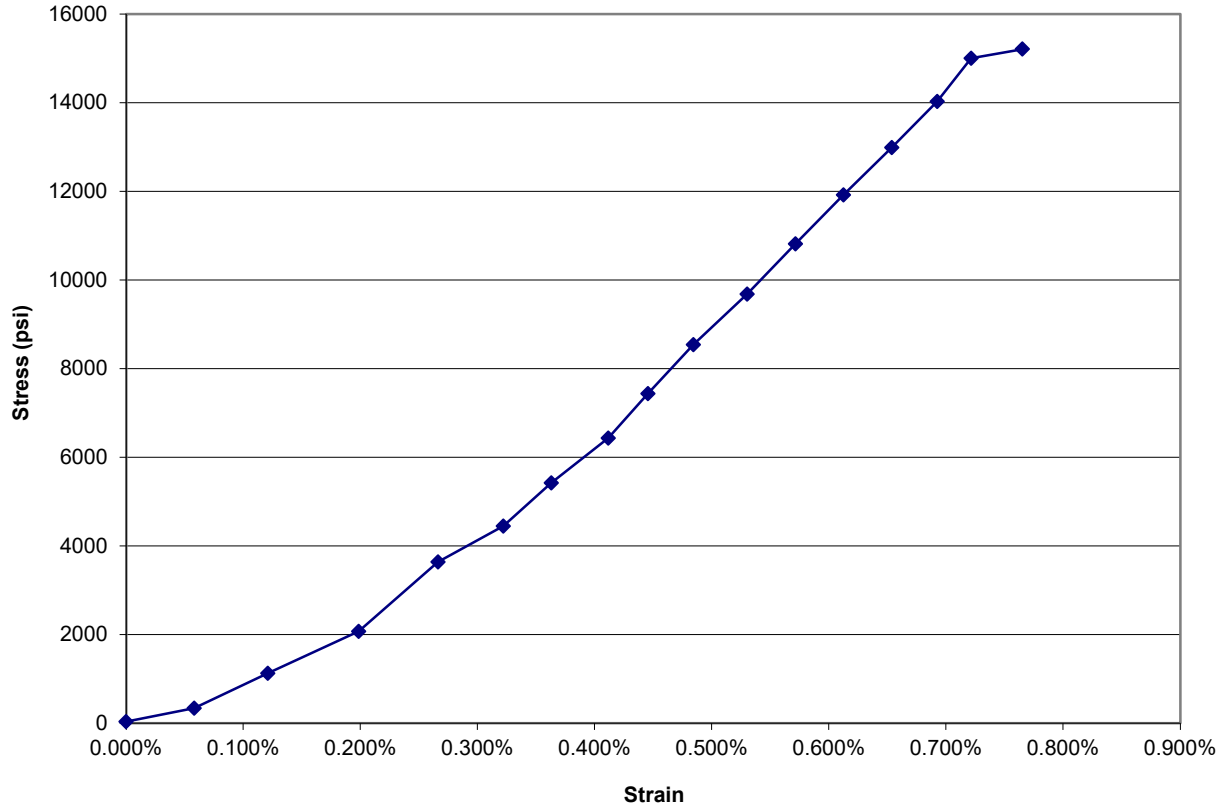
Tested By: CAG/AGS

Checked By: MTG

MTG

## Unconfined Compressive Strength of Intact Rock Core ASTM D2938

Unconfined Compressive Strength



### Unconfined Compressive Strength ASTM D2166

Project: Proposed Maine Dep of Inland Fisheries & Wildlife HQ  
RWG&A Project No: 0767-166  
Boring No: B-104  
Sample No: R-1  
Depth: 9.9-14.9'

Location: Augusta, ME  
Lab Sample No: 17822  
Date: 01/10/2024  
Description: Schist

Height:	4.130 in.	Unconfined Compressive Strength:	15209 psi
Diameter:	1.980 in.	Strain at Failure (%):	0.765 %
H/D Ratio:	2.09		
Weight:	1.273 lbs		

R. W. Gillespie & Associates

20 Pomerleau St Suite 100  
Biddeford, ME 04005

P.O. Box 289  
Augusta, ME 04332

177 Shattuck Way, Suite 1 West  
Newington, NH 03801



**APPENDIX G**

**RECOVERED ROCK CORE PHOTOGRAPHS**

Geotechnical Engineering Evaluation  
Proposed Maine Department of Inland Fisheries & Wildlife Headquarters  
Augusta, Maine

Proposed Maine Department of Inland Fisheries & Wildlife Headquarters  
Augusta, Maine  
RWG&A Project No. 0767-166

Boring No.	Run	From (feet)	To (feet)	Length (inches)	Recovery (inches)	Percent Recovery	RQD percent
B-104	1	9.9	14.9	60	60	100	70



Proposed Maine Department of Inland Fisheries & Wildlife Headquarters  
Augusta, Maine  
RWG&A Project No. 0767-166

Boring No.	Run	From (feet)	To (feet)	Length (inches)	Recovery (inches)	Percent Recovery	RQD percent
B-203	R-2	19.2	23.5	51	50	98	85



## SECTION 312319 - DEWATERING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Construction dewatering.

B. Related Requirements:

1. Section 013233 "Photographic Documentation" for recording preexisting conditions and dewatering system progress.
2. Section 312000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.
3. Section 334600 "Subdrainage" and Section 315000 "Excavation Support and Protection" for permanent foundation wall, underfloor retaining wall, and footing drainage.

#### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review condition of site to be dewatered, including coordination with temporary erosion-control measures and temporary controls and protections.
3. Review geotechnical report.
4. Review proposed site clearing and excavations.
5. Review existing utilities and subsurface conditions.
6. Review observation and monitoring of dewatering system.

#### 1.3 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
3. Include written plan for dewatering operations, including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

NEW HEADQUARTERS BUILDING  
INLAND FISHERIES AND WILDLIFE – EAST CAMPUS  
AUGUSTA, MAINE

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Field Quality-Control Submittals:
  - 1. Field quality-control reports.
- C. Qualification Statements: For Installer.
- D. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.

1.5 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Installer: An experienced installer that has specialized in design of dewatering systems and dewatering work.

1.6 FIELD CONDITIONS

- A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.
  - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering in accordance with the performance requirements.
  - 2. The geotechnical report is included in Appendix A of Section 312000 “Earth Moving.”

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of groundwater and permit excavation and construction to proceed on dry, stable subgrades.
  - 1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
  - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.

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3. Prevent surface water from entering excavations by grading, dikes, or other means.
  4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
  5. Remove dewatering system when no longer required for construction.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction. Comply with most recent Maine Department of Environmental Protection Erosion and Sediment Control Practices Guidelines.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
  2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 311000 "Site Clearing," during dewatering operations.

#### 3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
1. Space well points or wells at intervals required to provide sufficient dewatering.
  2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Place dewatering system into operation to lower water to specified levels before excavating below groundwater level.

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- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

### 3.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control groundwater to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
  - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
  - 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
  - 3. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Contain all discharged turbid water without any flow to a natural resource.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

### 3.4 FIELD QUALITY CONTROL

- A. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.
- B. Prepare reports of observations.

### 3.5 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION

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SECTION 316329 – MICROPILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. Micropile is a small-diameter (less than 12 inches), drilled and grouted pile.

1.3 SYSTEM DESCRIPTION

- A. Prior to commencing any work on the micropile installation, the Contractor, including all field personnel to be involved in drilling and installation of the micropile, shall meet with the Owner to review the drawings and specifications, work plans, and submittals. Drilling may commence upon approval of the micropile installation plan and procedures described in paragraph SUBMITTALS and after the conduct of the preinstallation meeting.
- B. General Requirements: The work includes design, fabrication and installation and testing of the micropile system. The micropile shall be fabricated and installed as shown on the drawings. Prepare Design Fabrication and Installation Drawings and an Installation Plan for approval. Micropile installation will occur within the existing building with limited headroom. Use of "low-clearance" drill rigs may be required.
- C. Scope of Work: The Work covered by this section, without limiting the generality thereof, consists of furnishing all plant, labor, equipment, appliances and materials and performing all operations in connection with the design, installation, and testing of micropile with allowable design capacity as indicated on the drawings, cement grouted, drilled-in piles at the locations and to the alignments as shown on the Drawings and includes, but is not limited to the following:
  - 1. The design of the piles to achieve an allowable design capacity of 60 tons in comparison and tension based on the criteria presented herein and shown on the Drawings. The factors of safety applied to the design shall be 3.0 for uplift and 3.0 for compression.
  - 2. Piles shall be fully cased with a minimum outside diameter of 8 inches. Each pile shall include a full-length steel core and a permanent steel casing as specified herein.
  - 3. Piles shall develop 100% of their load carrying capacity in side resistance.
  - 4. Pile design shall use an ultimate rock/grout bond stress of 180 psi with a minimum factor of safety of 3.0. Pile design must include provisions to account for and protect against corrosion loss.
  - 5. Drilling equipment and methods used by the Contractor shall permit advancement of casing through soils, gravel, cobbles, boulders, rubble fill, wood, bedrock and other materials, which are known to exist at the micropile locations. Where piles cannot penetrate obstruction, offset pile by a minimum of one pile diameter and provide an additional pile.



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6. Drilled piles shall be installed in a manner that does not impact existing structures and must minimize the loss of ground beyond the pile diameter.
7. Grouting of piles must be completed in one of continuous operation.
8. Provide survey control, layout of design pile locations and as-built plans by a licensed land surveyor.
9. Conduct one (1) acceptable pile compressive load test to a minimum ultimate load of 2.0 times design compressive load in accordance with applicable requirements of this Section. Pile test shall be completed in accordance with the most recent version of ASTM D1143/D1143M, Procedure A (Quick Test).
10. Conduct one (1) acceptable pile tensile load test to a minimum ultimate load of 2.0 times design tensile load in accordance with applicable requirements of this section. Pile test shall be completed in accordance with the most recent version of ASTM D 3689, Procedure A (Quick Test).
11. Test piles may be used as production piles provided the pile is designed with a structural factor of safety of at least 1.25 at maximum test load, the pile is not failed or overloaded during testing, and the pile can be replaced if the pile fails.
12. Conduct proof load tests on a minimum of five percent of production piles. Proof test must not be less than 1.67 times the design axial compressive load. Complete proof load test in accordance with ASTM D1143/D1143M, Procedure A (Quick Test).

1.4 SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Shop Drawings:
  1. Design Drawings.
  2. Fabrication and Installation Drawings.
  3. Drawings and detailed installation procedures and sequences showing complete details of the installation procedure and equipment stamped by a licensed professional engineer in the State of Maine qualified for this type of design.
- C. Product Data
  1. Installation Plan
  2. Casing
    - a. Details of equipment and procedures for pile installation including number of drill rigs, and means and methods for drilling through obstructions.
    - b. Provide details of the pile including: casing, reinforcing, reinforcement connection methods, procedures for placement of grout (including post grouting if employed), steel core centralizers, and other items pertinent to pile installation.
    - c. Planned construction and drilling sequence.
- D. Design Data:
  1. Design Drawings.
    - a. Drawings and design calculations indicating proposed pile capacities, pile diameter and materials, length in bearing stratum, pile layout, details of the pile including

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- splice details, reinforcing, procedures for placement of grout, and other items pertinent to pile installation. A qualified licensed professional engineer must stamp drawings and calculations.
  - b. Details of equipment and procedures for pile installation, and including but not limited to laydown/staging area requirements and means of handling drilling spoils.
  - c. Submit proposed reinforcement splice detail, if applicable.
- 2. Cement Grout Mix Design.
- 3. Cement Grout Mix Design Proposed for use.
- 4. Pile Load Tests:
  - a. Details and sketches of pile load set-up, monitoring devices, and equipment.
  - b. Details of loading sequence.
  - c. Jack calibration details.
  - d. Load cell calibration details.
- E. Test Reports:
  - 1. Pile Load Tests.
  - 2. Grout Mix Proportions.
  - 3. Grout Compressive Strength.
- F. Certificates:
  - 1. Designer Qualifications.
  - 2. Installer Qualifications.
  - 3. Pile Materials.
  - 4. Field Testing Technician.
- G. Closeout Submittals:
  - 1. As Built Data.
  - 2. Actual pile location data shall be submitted within seven working days after a pile is installed. The Contractor shall provide the Owner with written tabulation indicating the following information:
    - a. Pile number.
    - b. Elevation of top of each pile after installation of the cap plate (measured to the nearest 0.05 feet).
    - c. Deviation from design plan location (measured to the nearest 0.01 feet).
    - d. Alignment and slope angle.

## 1.5 QUALITY ASSURANCE

- A. Submit micropile designer, fabricator and installer qualifications for approval in accordance with submittals paragraph. The submittals shall, where applicable, identify individuals who will be working on this contract and their relevant experience. No changes shall be made in approved personnel without prior approval of the Owner.

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- B. Special Deep Foundation Inspector Qualifications: Refer to Section 01 45 35 SPECIAL INSPECTIONS for qualifications and responsibilities of the deep foundation special inspector engaged by Owner.
- C. Field Monitoring and Testing:
  - 1. Cement grout test cubes or cylinders shall be taken and tested by the Contractor, who shall also facilitate storing samples. The Contractor shall obtain a minimum of two seven-day and two twenty-eight day compressive strength tests per grout mix. It is the Contractor's responsibility that grout cubes or cylinders be stored in an approved storage box, provided by the Contractor, for 24 hours after molding and held at a temperature between 60 to 80 degrees F.
  - 2. Certification of the quality of the pile materials to be used in the Work shall be furnished, in a form acceptable to the Owner, at the time of delivery of materials to the site. Pile materials shall also be subject to on-site observation for conformance with specifications.
  - 3. Approvals and acceptance given by the Owner or their representative shall not relieve the Contractor of the responsibility for performing the Work in accordance with the Contract Documents.
- D. Lines and Grades:
  - 1. The Contractor shall be responsible for the correct location and alignment of piles and keeping a record of the piles installed.
  - 2. The Contractor shall establish, maintain and record all locations and elevations required, including the elevation of the top of the pile and casing, the bottom of the pile and casing, and other location and elevation information required regarding the piles.
- E. Designer Qualifications: The micropiles shall be designed by Professional Engineers who have designed a minimum of three micropile projects similar in size and scope to this project within the past ten years. The drawings and calculations shall be signed by the Professional Engineer.
- F. Installer Qualifications: The micropiles shall be installed by a Contractor who is regularly engaged in the installation of micropile and has at least five years' experience in the installation of similar micropile. The Contractor shall have installed micropile on at least five projects of similar scope and size.

1.6 SITE CONDITIONS

- A. A foundation investigation at the site and data is presented in the subsurface soil boring logs. While the foundation information is representative of subsurface conditions at the respective locations, local variations in the characteristics of the subsurface materials may be anticipated. Local variations which may be encountered include, but are not limited to, classification and thickness of rock strata, fractures, and other discontinuities in the rock structure, and variation in the soil classifications. Such variations will not be considered as differing materially within the purview of the CONTRACT CLAUSES, paragraph Differing Site Conditions. The boring information presents the subsurface conditions at the boring locations only. Subsurface conditions between the boring locations can vary and the Contractor shall consider this and take proper precautions and actions to account for these unknown conditions. The Contractor is responsible for verifying the location of all utilities that may be affected by construction or the installation of the anchors.

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1.7 MINIMUM PILE INSTALLATION CRITERIA

- A. General: Design and installation details of the piles shall be in accordance with previously accepted and approved submittals, including design drawings.
- B. Subsurface Conditions: The primary subsurface units encountered in the land borings include fill, concrete, alluvial/glacial soils, and bedrock including quartzite with varying degrees of weathering.
- C. Pile Embedment: The minimum pile embedment into competent bedrock shall be 5 feet.
- D. Pile Diameter:
  - 1. Each pile shall have a minimum outside diameter of 8 inches.
  - 2. The design pile diameter within the bedrock shall be taken as the outside diameter of the casing or the diameter of the drill bit attached to the bottom of the temporary casing.
- E. Pile Installation: Pile installations shall be designed in accordance with the following criteria:
  - 1. Piles shall be formed with a steel core and grout encasement to transfer load to the bearing stratum.
  - 2. Maximum allowable stress in the steel shall be forty percent of the minimum specified yield strength, but shall not exceed 24,000 psi on the area of the steel. The allowable stress on the cement grout shall be 33 percent of the 28 day unconfined compressive strength, but not exceeding 1,600 psi.
  - 3. The steel shall satisfy the seismic reinforcement criteria.
  - 4. Minimum thickness of grout cover over core steel shall be two inches.
  - 5. The steel core shall be centered in the pile full-depth using centralizers spaced at 10-foot intervals.
  - 6. The mating ends of the steel core sections shall be spliced so as to safely withstand the stresses to which they may be subjected. Each core steel section and splice shall be assembled to develop the full compressive strength of the section.
  - 7. No end bearing shall be allowed in the computation of pile capacity.
  - 8. Piles may not be loaded until the cement grout has achieved design compressive strength.
  - 9. Pipe casing shall be designed with an additional 1/16-inch minimum wall thickness as a corrosion allowance.

1.8 CONDUCT OF WORK

- A. Piles shall be installed at the locations shown on the Drawings. The design, materials, equipment and installation procedures developed shall avoid any detrimental effects to the existing buildings or structures, unnecessary noise or vibrations, and damage to the adjacent property. The Contractor shall be completely and solely be responsible for job safety and security.
- B. The Contractor shall have the known utility locations in the vicinity of proposed pile locations marked in the field by utility companies prior to commencing work. The Contractor is responsible for all Dig-Safe calls and utility clearance and coordination. In addition, the Contractor shall be responsible for completing pile installation without damage to any utilities or other substructures.

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- C. The Contractor shall provide provisions to control flow of water/cuttings and disposal of same, and shall keep the premises clean and free of water and debris from the drilling/pile installation work, such that other work activities are not interrupted.
- D. The Contractor shall repair any damage to existing structures or property caused from performing the Work as described herein.
- E. Drilled Pile Interaction and Sequencing: Drilled pile installation sequence shall be determined prior to the start of Work.

## PART 2 - PRODUCTS

### 2.1 CEMENT AND GROUT

- A. Cement Grout: Cement Grout for Piles shall conform to the requirements of ASTM C 94/C 94M using Type II or equivalent Portland Cement.
  - 1. Grout Mix Proportions: The cement grout mix design shall have a minimum 28-day compressive strength(f c) of 4,000 psi, a minimum water/cement ratio of 0.45, using Type II or equivalent Portland Cement.

### 2.2 STEEL CORE

- A. Steel core reinforcement as a minimum shall be standard deformed steel conforming to the requirements of ASTM A 615/A 615M, Grade 60 or Grade 75; a structural steel section conforming to ASTM A36/A36M; welded or seamless pipe conforming to ASTM designations A53, A252, A500, A501 or A618, or equivalent. Reinforcing steel shall be sufficient to resist tension loads during load testing.

### 2.3 CASING

- A. Permanent steel casing shall have a minimum wall thickness of 0.5 inches. Steel casing shall conform to one of the following ASTM designations: ASTM A53/A53M, ASTM A 252, ASTM A500/A500M, ASTM A 501 or ASTM A618/A618M.
- B. Temporary Casing: Temporary casing shall be of sufficient strength to avoid collapse and allow for proper installation of steel core and cement grout.

## PART 3 - EXECUTION

### 3.1 DRILLING HOLES

- A. General: Piles shall be installed to the line, alignment, and grades specified in the drawings.

### 3.2 METHOD OF INSTALLATION

- A. General: The method of pile installation shall be determined by the Contractor, subject to review by the Owner. Pile installation shall be made by non-displacement such as rotary drilling. Wet rotary

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drilling methods shall employ sufficient fluid pressure to provide complete removal of the drill cuttings from the hole. Air drilling shall employ sufficient air pressure to remove drill cuttings from the hole.

- B. External flush or wash methods for advancement of casing shall not be used. Drilling shall be made in such a manner to prevent loss of ground beyond the specified pile diameter. Drilling mud or other methods shall be employed as required to stabilize the hole and prevent loss of ground. Drilling mud in the hole shall be sufficiently fluid such that it is readily and fully displaced by the cement grout.
- C. Drilling equipment and methods shall permit the advancement of casing through materials encountered.
- D. All excavation and drilling spoils shall be controlled to minimize disturbances to site conditions and hindrances to pile installation procedures and requirements. Refer to Section 31 23 00.00 22 EXCAVATION AND FILL for management of drilling spoils.
- E. The Contractor is responsible for controlling the amount of dust and dirt created by the pile installation process using whatever methods are most appropriate.
- F. All piles shall be installed at locations noted on the contract Drawings. Pile locations shall be checked during installation and appropriate measures taken as necessary to maintain the correct pile location. Each pile shall be drilled to achieve the foundation support within the identified bearing strata and shall be capable of supporting the specified design load.
- G. Grouting of the piles shall provide complete filling of the pile with a minimum of segregation. Grout shall be placed by means of a tremie pipe and grout pump from the bottom of the pile upward in one continuous operation until the pile is filled and suitable, undiluted cement grout returns at the top of the pile. The cement grout shall not be allowed to fall freely through slurry or water.
- H. Core steel shall be centered in the hole with appropriate centering devices. Place steel core after initial grouting and before commencing removal of the casing within the bearing length of the pile and pressure grouting.
- I. Sequence of pile installation shall be such that adjacent piles, or piles located less than 10 ft from the pile to be drilled, are not installed within 24 hours after initial grouting or post grouting of previously installed piles.

### 3.2 CRITERIA FOR ACCEPTANCE

#### A. Pile Load Tests:

1. One (1), micropile shall be compressive load tested in accordance with ASTM D1143/D1143M to a minimum load of 2 times the design compressive load and one (1) micropile shall be tensile load tested in accordance with ASTM D 3689 to a minimum load of 2 times the design tensile load before installing production micropiles. If the pile load test indicates that the micropile did not perform in accordance with the design load, the Contractor shall redesign the piles using the load test data and submit such design to the Owner for review.
2. The Contractor shall provide all labor, materials and equipment required to set up, conduct, and dismantle the load test.

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3. The test pile shall be installed by the methods and equipment specified for production piles, including permanent casing (if necessary).
4. Grout Compressive Strength: Grout in the test piles shall have attained a minimum compressive strength of 4,000 psi prior to load testing. The Contractor shall provide substantiating compressive strength test data prior to load testing.

B. Pile Instrumentation:

1. The Contractor shall provide telltales within the pile to enable the Owner to monitor movement at the top and bottom of the bedrock.
2. The Contractor shall assist the Owner with the reading of the instrumentation.

C. Test Procedures:

1. Load shall be applied to the test pile by means of a hydraulic jack operated by the Contractor which reacts against a pile or cribbing supported reaction beam. Support shall be at least 10 feet away from the test pile. Temporary piles for support of the reaction and reference beam systems shall be removed to a depth of at least 5 ft below finished grade.
2. The hydraulic jack shall have a capacity of at least 200 tons and shall be capable of moving the pile a minimum of 6 inches.
3. The top of the test pile shall be level and capped to provide a horizontal bearing surface.
4. The Contractor will furnish and install up to three micrometer dial indicators (range of 2 inches, graduated in 0.001 inch divisions).
5. Micrometer dial indicators shall be mounted to one or more steel reference beams provided and installed by the Contractor. The beam(s) shall be rigid and supported by piles or cribbing at a distance of at least 10 feet from the test pile. The reference beams shall be fixed at one end and shall be free to move horizontally at the other end to allow for expansion and contraction of the reference beam without vertical deflection at points where dials are mounted. Wood or other materials subject to variations in moisture content shall not be used in reference beams, crossbeams, shims, or for any other means of dial support.
6. The Contractor shall protect the entire measuring apparatus against disturbances which may affect the reliability of the settlement observations. The Contractor shall provide suitable heaters and suitable enclosures to maintain the temperature around the test apparatus at a minimum of 40 degrees F, and shall provide temporary lighting as necessary.
7. Loading and unloading of the test pile shall be performed only in the presence of a representative of the Field Testing Technician and Owner, and in accordance with the requirements of ASTM D 3689 or ASTM D1143/D1143M.
8. Proof load tests shall be performed on a minimum of 5% of the production piles. Proof load test shall be conducted in accordance with ASTM D1143/D1143M.

a. General

3.3 TOLERANCES FOR ACCEPTANCE

- A. General: Piles shall be installed as close as practicable to the required alignment and locations. A maximum lateral deviation from the correct location at cut-off elevation permitted will be 1 inch. Prepare the existing rock surface as necessary to comply with the lateral deviation requirements. A maximum deviation from design cut-off elevation equal to one inch will be permitted.

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- B. Piles which are believed to have collapsed, based on the grout take volume, or which are otherwise unsatisfactory as specified above and which cannot be removed or repaired, shall be abandoned and filled with cement grout.
- C. Piles that are rejected because of damage, mislocation or misalignment, or failure to meet other installation criteria, shall be cut off below the design cut-off grade and abandoned. Additional pile(s) shall be installed as necessary subject to review by the Owner. Whenever, in the judgment of the Owner, misalignment or rejection of a pile is caused by the Contractor's violation of the specifications or other error on the Contractor's part, and installation of one or more replacement piles is necessitated, the cost of such re-installation (and load testing if required) shall be borne by the Contractor.
- D. Contractor shall prepare and submit as built data.

3.6 SPECIAL INSPECTIONS

- A. Owner will perform special inspections in accordance with Section 014535 SPECIAL INSPECTIONS.

END OF SECTION



## SECTION 321216 - ASPHALT PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Hot-mix asphalt paving.
- 2. Hot-mix asphalt overlay.
- 3. Hot-mix asphalt patching.
- 4. Granite curbing.
- 5. Asphalt surface treatments.
- 6. Traffic signs.
- 7. Guardrails.

- B. Related Requirements:

- 1. Section 311000 "Site Clearing" for demolition and removal of existing asphalt pavement.
- 2. Section 312000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
- 3. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.
- 4. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.
- 5. Section 321400 "Unit Paving" for bituminous setting bed for pavers and for stone and precast concrete curbs.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
  - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
  - b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

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1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: Include technical data and tested physical and performance properties for each product.
- C. Hot-Mix Asphalt Designs:
  - 1. Certification, by authorities having jurisdiction, of approval of each hot-mix asphalt design proposed for the Work.
  - 2. For each hot-mix asphalt design proposed for the Work.
- D. Sustainable Design Submittals:
  - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For paving-mix manufacturer.
- C. Material Certificates: Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the Maine Department of Transportation.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Maine Department of Transportation Standard Specifications for Highways and Bridges (SHS-MDOT) for asphalt paving work.
  - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

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1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
  - 1. Prime Coat: Minimum surface temperature of 50 deg F.
  - 2. Tack Coat: Minimum surface temperature of 50 deg F.
  - 3. Asphalt Binder Course: Minimum surface temperature of 40 deg F and rising at time of placement.
  - 4. Asphalt Wearing Course: Minimum surface temperature of 50 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Comply with SHS-MDOT, Section 703.07, 0.3 to 3 million 18-Kip ESALS.

2.2 ASPHALT MATERIALS

- A. Comply with SHS-MDOT, Section 702.01, Performance Graded Asphalt Binder (PGAB) PG64-28.
- B. Tack Coat: Conforming to SHS-MDOT Section 409.
- C. Water: Potable.

2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Sand: ASTM D1073, Grade No. 2 or No. 3.

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2.4 MIXES

- A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent or more than 25 percent by weight.
  - 1. Surface Course Limit: Recycled content no more than 10 percent by weight.
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by Maine DOT authorities and complying with the following requirements:
  - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  - 2. Binder Course: 19 mm Superpave, SHS-MDOT, Section 703.09.
  - 3. Wearing Course: 12.5 mm Superpave, SHS-MDOT, Section 703.09.
  - 4. Wearing Course on Sidewalks : 9.5 mm Superpave, SHS-MDOT, Section 703.09

2.5 TRAFFIC SIGNS

- A. Provide in conformance with SHS-MDOT and latest version of the Manual or Uniform Traffic Control Devices (MUTCD).

2.6 CURBS

- A. Granite Curb: MDOT, Section 712.04, Vertical Granite Curb (Type I and Type V).

2.7 GUARDRAILS

- A. Timber Guardrail: Provide as indicated.
  - 1. Hardware: Corten weathering steel.
  - 2. Timber: #1 Grade Southern Yellow Pine, sanded on all sides, and CCA pressure treated to a net retention of 0.60 lb/cu. ft. per AWPA Standard C14.
  - 3. Steel backing and splice plates as required by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proceed with paving only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
  - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3.3 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd..
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Placing Two-Course Patch Material: Partially fill excavated pavements with hot-mix asphalt base course mix and, while still hot, compact. Cover asphalt base course with compacted layer of hot-mix asphalt surface course, finished flush with adjacent surfaces.

3.4 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
  - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
  - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
  - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
  - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

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3.5 SURFACE PREPARATION

- A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.
- B. Herbicide Treatment: Apply herbicide in accordance with manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
  - 1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 HOT-MIX ASPHALT PLACEMENT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  - 2. Place hot-mix asphalt wearing course in single lift.
  - 3. Spread mix at a minimum temperature of 250 deg F.
  - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
  - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
  - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
  - 2. Complete a section of asphalt base course before placing asphalt wearing course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

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1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method in accordance with AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

### 3.8 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
  1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  1. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.9 CURB INSTALLATION

- A. Granite Curbs: Install according to MDOT, Section 609.03, unless indicated otherwise.

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3.10 SIGN INSTALLATION

- A. Install according to MDOT Standard Specifications, Section 645.

3.11 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/2 inch.
  - 2. Wearing Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch.
  - 2. Wearing Course: 1/8 inch.
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.12 GUARDRAIL INSTALLATION

- A. Install as indicated and according to manufacturer's written requirements to maintain crashworthiness NCHRP 350 Test level 2 criteria (low speed roadways up to 45 mph).

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Thickness: Determine in-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549/D3549M.
- C. Surface Smoothness: Test finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency must take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979/D979M.
  - 1. Determine reference maximum theoretical density by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041/D2041M, and compacted in accordance with job-mix specifications.
  - 2. Determine in-place density of compacted pavement by testing core samples in accordance with ASTM D1188 or ASTM D2726/D2726M.
    - a. Take one core sample for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.



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- b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950/D2950M and coordinated with ASTM D1188 or ASTM D2726/D2726M.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.14 WASTE HANDLING

- A. General: Handle asphalt-paving waste in accordance with approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION

## SECTION 321313 - CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes concrete paving including the following:
  - 1. Walks.
  - 2. Precast concrete wheel stops.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
  - 2. Section 321316 "Decorative Concrete Paving" for stamped concrete other than stamped detectable warnings.
  - 3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
  - 4. Section 321726 "Tactile Warning Surfacing" for detectable warning tiles.

#### 1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
    - a. Concrete mixture design.
    - b. Quality control of concrete materials and concrete paving construction practices.
  - 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete paving Subcontractor.

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1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
  - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
  - 2. Regional Materials: Manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- D. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- E. Precast concrete wheel stops.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.
- C. Material Certificates: For the following, from manufacturer:
  - 1. Cementitious materials.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Fiber reinforcement.
  - 4. Admixtures.
  - 5. Curing compounds.
  - 6. Applied finish materials.
  - 7. Bonding agent or epoxy adhesive.
  - 8. Joint fillers.
- D. Material Test Reports: For each of the following:
  - 1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- E. Field quality-control reports.

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1.6 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
  - 1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.8 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
- D. Penetrating Sealer:

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1. Do not apply Penetrating Sealer when temperatures are expected to fall below 40 deg F within 12 hours or when rain is expected within 4 hours following the application.
2. Coordinate installation work with other trades. The applicator shall have sole right of access to the specified areas for the time needed to complete the application.
3. Warn personnel against contact of material to eyes. Wear applicable protective clothing and respiratory protection gear.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
  1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] [60] <Insert value> percent.
- B. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.
- C. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.
- D. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.
- E. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.4 CONCRETE MATERIALS

- A. Regional Materials: Verify concrete is manufactured within 100 miles of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

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- B. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - 1. Portland Cement: ASTM C150/C150M, gray portland cement Type I or Type II.
  - 2. Fly Ash: ASTM C618, Class C or Class F.
  - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
  - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
  - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  - 2. Retarding Admixture: ASTM C494/C494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- F. Water: Potable and complying with ASTM C94/C94M.

## 2.5 FIBER REINFORCEMENT

- A. Synthetic Fiber, Monofilament Fibers: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
    - b. FORTA Corporation.
    - c. FullForce by ABC Polymer Industries, LLC.
    - d. GCP Applied Technologies Inc.
    - e. Nycon Corporation.
    - f. Propex Operating Company, LLC.
    - g. Sika Corporation.
- B. Synthetic Fiber, Fibrillated Fibers: Fibrillated polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
  - b. FORTA Corporation.
  - c. FullForce by ABC Polymer Industries, LLC.
  - d. GCP Applied Technologies Inc.
  - e. Nycon Corporation.
  - f. Propex Operating Company, LLC.
  - g. Sika Corporation.

2.6 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Bon Tool Co.
  - b. Brickform; a division of Solomon Colors.
  - c. ChemMasters, Inc.
  - d. Dayton Superior Corporation.
  - e. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
  - f. Kaufman Products, Inc.
  - g. Lambert Corporation.
  - h. Laticrete International, Inc.
  - i. Master Builders Solutions, brand of MBCC Group, a Sika company.
  - j. Metalcrete Industries.
  - k. Nox-Crete Products Group.
  - l. Sika Corporation.
  - m. SpecChem, LLC.
  - n. TK Products Construction Coatings, a Fenix Group SPC Company.
  - o. Vexcon Chemicals Inc.
  - p. W. R. Meadows, Inc.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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- a. [Anti-Hydro International, Inc.](#)
- b. [ChemMasters, Inc.](#)
- c. [Dayton Superior Corporation.](#)
- d. [Euclid Chemical Company \(The\); a subsidiary of RPM International, Inc.](#)
- e. [Kaufman Products, Inc.](#)
- f. [Lambert Corporation.](#)
- g. [Laticrete International, Inc.](#)
- h. [Nox-Crete Products Group.](#)
- i. [Right Pointe.](#)
- j. [SpecChem, LLC.](#)
- k. [TK Products Construction Coatings, a Fenix Group SPC Company.](#)
- l. [Unitex; a Brand of Dayton Superior Corporation.](#)
- m. [Vexcon Chemicals Inc.](#)
- n. [W. R. Meadows, Inc.](#)

2.7 RELATED MATERIALS

- A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber in preformed strips.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
  1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
  1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
  2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  1. Fly Ash or Pozzolan: 25 percent.
  2. Slag Cement: 50 percent.
  3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:



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1. Air Content, 3/4-inch Nominal Maximum Aggregate Size: 5-1/2 percent plus or minus 1-1/2 percent.
- D. Limit water-soluble, chloride-ion content in hardened concrete to [0.15] [0.30] percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
  1. Use water-reducing admixture, high-range, water-reducing admixture, and plasticizing and retarding admixture in concrete as required for placement and workability.
  2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.
- G. Concrete Mixtures: Normal-weight concrete.
  1. Compressive Strength (28 Days): 4000 psi.
  2. Maximum W/C Ratio at Point of Placement: 0.45.
  3. Slump Limit: 4 inches, plus or minus 1 inch.

## 2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.
  1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## 2.10 PRECAST CONCRETE WHEEL STOPS

- A. Precast, steel-reinforced, air-entrained concrete; 4000-psi minimum compressive strength; manufacturer's standard height and width by 72 inches long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.
  1. Source Limitations: Obtain wheel stops from single source from single manufacturer.
  2. Surface Appearance: Smooth, free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
  3. Surface Sealer: Manufacturer's standard salt-resistant, clear sealer applied at precasting location.
  4. Mounting Hardware: Galvanized-steel spike or dowel hardware as standard with wheel-stop manufacturer.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 INSTALLATION OF STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.
- F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

### 3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
  - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
  - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
  - 2. Provide tie bars at sides of paving strips where indicated.
  - 3. Butt Joints: Use epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
  - 1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
  - 2. Extend joint fillers full width and depth of joint.
  - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
  - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Control Joints: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
  - 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint with grooving tool as indicated. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
    - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
  - 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

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- a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

### 3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

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1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
  1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PENETRATING SEALER

- A. Examine all concrete surfaces for deficiencies. If deficiencies are encountered, notify the Architect in writing and provide recommendations for repairs required. Repair all deficiencies as directed by the Architect.
- B. Protection: Protect adjacent surface in accordance with manufacturer's written recommendations.

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- C. Application: Apply in accordance with manufacturer's written recommendations.

3.10 WHEEL STOP INSTALLATION

- A. Verify that pavement is in suitable condition to begin installation in accordance with manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Install wheel stops in accordance with manufacturer's written instructions unless otherwise indicated.
- D. Prior to anchoring, confirm with University that it is desired to have the wheel stops permanently anchored to the pavement. Once the University has confirmed in writing, securely anchor wheel stops to substrate with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

3.11 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
  - 1. Elevation: 1/4 inch.
  - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  - 3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
  - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
  - 5. Lateral Alignment and Spacing of Dowels: 1 inch.
  - 6. Vertical Alignment of Dowels: 1/4 inch.
  - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
  - 8. Joint Spacing: 3 inches.
  - 9. Control Joint Depth: Plus 1/4 inch, no minus.
  - 10. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:
  - 1. Testing Frequency: Obtain at least one composite sample for each 20 cu. yd. or fraction thereof of each concrete mixture placed each day.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

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2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
    - a. A compressive-strength test to be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.13 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

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- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION



SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Joint-sealant backer materials.
3. Primers.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. Concrete pavement joint sealants.
2. Joint-sealant backer materials.

1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Qualification Statements: For Installer and testing agency.

C. Product Certificates: For each type of joint sealant and accessory.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Performed by a qualified testing agency.

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1.6 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backer materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Crafco Inc.
    - b. Pecora Corporation.
    - c. The Dow Chemical Company.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D5893M, Type SL.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Crafco Inc.
    - b. Pecora Corporation.
    - c. The Dow Chemical Company.
- C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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- a. W. R. Meadows, Inc.

2.3 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backers to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of joint-sealant backer materials.
  - 2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
  - 3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:
  - 1. Place joint sealants so they fully contact joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
  - 1. Remove excess joint sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

### 3.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

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3.5 PAVING-JOINT-SEALANT SCHEDULE

A. Joints within concrete paving:

1. Joint Location:
  - a. Expansion and isolation joints in concrete paving.
  - b. Contraction joints in concrete paving.
  - c. Other joints as indicated.
2. Joint Sealant: Single-component, self-leveling, silicone joint sealant or multicomponent, nonsag, urethane, elastomeric joint sealant.
3. Joint-Sealant Color: Manufacturer's standard as selected to match the color of concrete paving.

END OF SECTION

## SECTION 321723 - PAVEMENT MARKINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Painted markings applied to asphalt paving.

- B. Related Requirements:

- 1. Section 071800 "Traffic Coatings" for painting whole areas of building floors and pavements with coatings having an integral wearing surface.
  - 2. Section 099113 "Exterior Painting" for painting exterior concrete surfaces other than pavement markings.
  - 3. Section 099123 "Interior Painting" for painting interior concrete surfaces other than pavement markings.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

- B. Product Data: Include technical data and tested physical and performance properties.

- 1. Pavement-marking paint, latex.

- C. Shop Drawings:

- 1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
  - 2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

#### 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Maine DOT and the latest version of the Manual of Uniform Traffic Control Devices for pavement-marking work.

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1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Aexcel Corporation.
  2. Colorado Paint Company II, LLC; SWARCO America, Inc.
  3. Columbia Paint & Coatings, Inc.; a subsidiary of Sherwin-Williams Company (The).
  4. Conco Paints.
  5. Diamond Vogel Paint Company.
  6. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).
  7. Ennis-Flint, Inc.
  8. Farrell-Calhoun.
  9. Florida Paints.
  10. General Paint.
  11. Insl-X Products; Benjamin Moore & Co.
  12. McCormick Paints.
  13. PPG Paints; PPG Industries, Inc.
  14. Rodda Paint Co.
  15. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
  16. Sherwin-Williams Company (The).
  17. The Dow Chemical Company.
  18. Transpo Industries, Inc.
- B. Source Limitations: Obtain pavement-marking paints from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.3 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint, Latex: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952F, Type II, with drying time of less than 45 minutes.

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1. Color: As indicated.
- B. Pavement-Marking Paint, Latex: MPI #97, latex traffic-marking paint.
  1. Color: As indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow asphalt paving or concrete surfaces to age for amount of time recommended by the manufacturer before starting pavement marking. Re-apply second coat, if necessary, when applying markings to freshen up placed pavement to ensure final thickness is equal to thickness of marking paint when applied to aged pavement.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils or manufacturer's recommended wet film thickness.
  1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION



## SECTION 321726 - TACTILE WARNING SURFACING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cast-in-place detectable warning metal tiles.
- B. Related Requirements:
  - 1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
  - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
  - 2. Regional Materials: Manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- D. Samples for Initial Selection: For each type of exposed finish requiring color selection.
- E. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

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1.5 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Mortar and Grout:
  - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
    - a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set unit pavers within 1 minute of spreading setting-bed mortar.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering and wear.
    - b. Separation or delamination of materials and components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

- A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for tactile warning surfaces.
  - 1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than percent.
- C. Regional Materials: Manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

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- D. Source Limitations: Obtain each type of tactile warning surfacing, joint material, setting material, anchor, and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

## 2.2 DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ADA Solutions, a division of SureWerx USA.
    - b. Advantage Tactile Systems.
    - c. EJ Group, Inc.
    - d. Neenah Foundry Company.
  2. Material:
    - a. Cast Iron: Gray iron, ASTM A 48/A 48M, CL 35.
  3. Shapes and Sizes:
    - a. Rectangular panel, as indicated.
  4. Dome Spacing and Configuration: Manufacturer's standard compliant spacing, in manufacturer's standard pattern.
  5. Mounting:
    - a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.

## 2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:
1. Furnish Type 304 stainless-steel fasteners for exterior use.
  2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.
- B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.
- C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION OF DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles:
  - 1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.
  - 2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
  - 3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.
  - 4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
  - 5. Clean tiles using methods recommended in writing by manufacturer.

#### 3.3 CLEANING AND PROTECTION

- A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.
- B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION

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SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Chain-link fences.
- 2. Swing gates.
- 3. Privacy slats.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete post footings.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

- B. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
  - a. Fence and gate posts, rails, and fittings.
  - b. Chain-link fabric, reinforcements, and attachments.
  - c. Accessories: Privacy slats.
  - d. Gates and hardware.

- C. Shop Drawings: For each type of fence and gate assembly.

- 1. Include plans, elevations, sections, details, and attachments to other work.
- 2. Include accessories, hardware, gate operation, and operational clearances.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Qualification Data: For testing agency and factory-authorized service representative.
- C. Product Certificates: For each type of chain-link fence, and gate.
- D. Product Test Reports: For framework strength according to ASTM F1043, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.6 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to comply with performance requirements.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - c. Faulty operation of gates.
  - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.
  - a. Minimum Post Size: Determine according to ASTM F1043 for post spacing not to exceed 10 feet for Material Group IA, ASTM F1043, Schedule 40 steel pipe.
- B. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

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2.2 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
1. Fabric Height: As indicated on Drawings.
  2. Steel Wire for Fabric: Wire diameter of 0.148 inch.
    - a. Mesh Size: 2 inches.
    - b. Zinc-Coated Fabric: ASTM A392, Type II, Class 2, 2.0 oz./sq. ft. with zinc coating applied before weaving with manufacturer's standard clear coating.
    - c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
  3. Selvage: Knuckled at both selvages, unless indicated otherwise on drawings.

2.3 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 based on the following:
1. Fence Height: As indicated on Drawings.
  2. Heavy-Industrial-Strength Material: Group IA, round steel pipe, Schedule 40.
    - a. Line Post: As indicated on drawings.
    - b. End, Corner, and Pull Posts: As indicated on drawings.
  3. Horizontal Framework Members: As indicated on drawings and according to ASTM F1043.
    - a. Top Rail: As indicated on drawings.
  4. Brace Rails: ASTM F1043.
  5. Metallic Coating for Steel Framework:
    - a. Type A: Not less than minimum 2.0-oz./sq. ft. average zinc coating according to ASTM A123/A123M or 4.0-oz./sq. ft. zinc coating according to ASTM A653/A653M.

2.4 SWING GATES

- A. General: ASTM F900 for gate posts, and single and double swing gate types.
1. Gate Leaf Width: As indicated.
  2. Framework Member Sizes and Strength: Based on gate fabric height as indicated.
- B. Pipe and Tubing:

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1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework.
2. Gate Posts: Round tubular steel.
3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: Welded.

D. Hardware:

1. Hinges: 360-degree inward and outward swing.
2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
3. Lock: Manufacturer's standard internal device.
4. Padlock and Chain: Obtain from Owner.

## 2.5 FITTINGS

A. Provide fittings according to ASTM F626.

B. Post Caps: Provide for each post.

1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: According to ASTM F626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
  - a. Hot-Dip Galvanized Steel: 0.148-inch-diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

I. Finish:



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1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.

2.6 PRIVACY SLATS

- A. Tubular Polyethylene Slats: Minimum 0.023-inch-thick tubular polyethylene, manufactured for chain-link fences from virgin polyethylene with UV inhibitor, sized to fit mesh specified for direction indicated, with fins for increased privacy factor.
- B. Color: As indicated on Drawings.

2.7 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.8 GROUNDING MATERIALS

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.
  1. Connectors for Below-Grade Use: Exothermic welded type.
  2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
  1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.
  - 1. Install fencing on established boundary lines inside property line.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set corner, terminal, and pull posts in concrete at indicated spacing into firm, undisturbed soil.
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Concealed Concrete: Place top of concrete below grade as indicated on Drawings to allow covering with surface material.
  - 3. Mechanically Driven Posts: Drive into soil to depth as indicated on drawings. Protect post top to prevent distortion.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
- E. Line Posts: Space line posts uniformly at 10 feet o.c. maximum.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
  - 1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- G. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

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1. Extended along top and bottom of fence fabric where indicated on drawings. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
- H. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- I. Intermediate and Bottom Rails: Secure to posts with fittings.
- J. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- K. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.
- L. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
  1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
- M. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- N. Privacy Slats: Install slats in direction indicated, securely locked in place.
  1. Diagonally for privacy factor of 80 to 85.

### 3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

### 3.5 GROUNDING AND BONDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fence and Gate Grounding:

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1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
  2. Install ground rods and connections at maximum intervals of 1500 feet.
  3. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
  4. Ground fence on each side of gates and other fence openings.
    - a. Bond metal gates to gate posts.
    - b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a ground rod located a maximum distance of 150 feet on each side of crossing.
- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- E. Connections:
1. Make connections with clean, bare metal at points of contact.
  2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  4. Make above-grade ground connections with mechanical fasteners.
  5. Make below-grade ground connections with exothermic welds.
  6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- F. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.
- G. Comply with requirements in Section 264113 "Lightning Protection for Structures."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests.
- B. Grounding Tests: Comply with requirements in Section 264113 "Lightning Protection for Structures."
- C. Prepare test reports.

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3.7 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION

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SECTION 323300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Seating.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts cast in concrete footings.
  - 2. Section 312000 "Earth Moving" for excavation for installing concrete footings.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
  - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- D. Samples: For each exposed product and for each color and texture specified.
- E. Samples for Initial Selection: For units with factory-applied finishes.
- F. Samples for Verification: For each type of exposed finish, not less than 6-inch-long linear components and 4-inch-square sheet components.

1.4 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For site furnishings to include in maintenance manuals.

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PART 2 - PRODUCTS

2.1 SEATING: BENCH

A. Manufacturer: Subject to compliance with requirements, provide products by the following:

1. “MultipliCITY Bench” by Landscape Forms ([www.landscapeforms.com](http://www.landscapeforms.com)).

B. Seat:

1. Material:

- a. Parallel wood planks on top of cast aluminum bench supports.

2. Overall Width: 95 inches.
3. Overall Height: 18 inches.
4. Overall Depth: 23 inches.
5. Seat Surface Shape: Flat.

C. Aluminum Finish: Anodized.

D. Wood Finish: Unfinished.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:

1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B211.
2. Extruded Bars, Rods, Wire, Profiles, and Tubes: ASTM B221.
3. Structural Pipe and Tube: ASTM B429/B429M.
4. Sheet and Plate: ASTM B209.
5. Castings: ASTM B26/B26M.

B. Wood: Surfaced smooth on four sides with eased edges; kiln dried, free of knots, solid stock of species indicated.

1. Wood Species: Ipe, FSC-certified.

2.3 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

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- C. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- D. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.4 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and positioned at locations indicated on Drawings.

END OF SECTION



SECTION 329115 - SOIL PREPARATION (PERFORMANCE SPECIFICATION)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes planting soils specified according to performance requirements of the mixes.
- B. Related Requirements:
  - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
  - 2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
  - 3. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

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- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- M. SSSA: Soil Science Society of America.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- Q. USCC: U.S. Composting Council.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include recommendations for application and use.
  - 2. Include test data substantiating that products comply with requirements.
  - 3. Include sieve analyses for aggregate materials.
  - 4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
    - a. Manufacturer's qualified testing agency's certified analysis of standard products.
    - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SU1P #25.
    - c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.
- C. Sustainable Design Submittals:
  - 1. Regional Materials.
- D. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

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1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For each testing agency.
- C. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
  - 1. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil.
- B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
  - 1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.8 SOIL-SAMPLING REQUIREMENTS

- A. General: Extract soil samples according to requirements in this article.
- B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Architect under the direction of the testing agency.
  - 1. Number and Location of Samples: Minimum of eight representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
  - 2. Procedures and Depth of Samples: According to soil testing agency.
  - 3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
  - 4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.9 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:
  - 1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
    - a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
    - b. Hydrometer Method: Report percentages of sand, silt, and clay.
  - 2. Bulk Density: Analysis according to core method of SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
  - 3. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
- C. Chemical Testing:
  - 1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
- D. Fertility Testing: Soil fertility analysis according to standard laboratory protocol of SSSA NAPT NEC-67, including the following:
  - 1. Percentage of organic matter.
  - 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
  - 3. Soil reaction (acidity/alkalinity pH value).
  - 4. Buffered acidity or alkalinity.
  - 5. Nitrogen ppm.
  - 6. Phosphorous ppm.
  - 7. Potassium ppm.
  - 8. Manganese ppm.
  - 9. Manganese-availability ppm.
  - 10. Zinc ppm.
  - 11. Zinc availability ppm.
  - 12. Copper ppm.
  - 13. Sodium ppm.
  - 14. Soluble-salts ppm.
  - 15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
  - 16. Lead scan.
  - 17. Other deleterious materials, including their characteristics and content of each.
- E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3-Chemical Methods."

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- F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
  2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Do not move or handle materials when they are wet or frozen.
  4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. **Regional Materials:** Acquire imported soil within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of Project site.

2.2 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

- A. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Using preconstruction soil analyses and materials specified in other articles of this Section, amend existing, on-site surface soil to become planting soil complying with the following requirements:
1. Particle Size Distribution by USDA Textures: Classified as sandy loam or loam soil according to USDA textures.
  2. Percentage of Organic Matter: Minimum 6 percent by volume.
  3. Soil Reaction: pH of 6 to 7.
  4. CEC of Total Soil: Minimum 10 meq/100 mL at pH of 7.0.

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5. CEC of Clay Fraction: Maximum 15 meq/100 mL at pH of 7.0.
  6. Soluble-Salt Content: 5 to 10 dS/m measured by electrical conductivity.
  7. Bulk Density: 1.2 g/cu. cm to 1.4 g/cu. cm at 85 percent compaction.
  8. Total Porosity: Minimum 50 percent at 85 percent compaction.
  9. Macro Porosity: Minimum 10 percent at 85 percent compaction.
- B. Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of sandy loam or loam soil according to USDA textures; and modified to produce viable planting soil. Amend imported soil with materials specified in other articles of this Section to become planting soil complying with the following requirements:
1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass.
  2. Additional Properties of Imported Soil before Amending: Minimum of 6 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration. Clean soil to be of the following:
    - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
    - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.
  3. Percentage of Organic Matter: Minimum 6 percent by volume.
  4. Soil Reaction: pH of 6 to 7.
  5. CEC of Total Soil: Minimum 10 meq/100 mL at pH of 7.0.
  6. CEC of Clay Fraction: Maximum 15 meq/100 mL at pH of 7.0.
  7. Soluble-Salt Content: 5 to 10 dS/m measured by electrical conductivity.
  8. Bulk Density: 1.2 g/cu. cm to 1.4 g/cu. cm at 85 percent compaction.
  9. Total Porosity: Minimum 50 percent at 85 percent compaction.
  10. Macro Porosity: Minimum 10 percent at 85 percent compaction.

## 2.3 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
  2. Form: Provide lime in form of ground mollusk shells.

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- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.
- E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C33/C33M.

## 2.4 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
  - 1. Feedstock: Limited to leaves.
  - 2. Reaction: pH of 5.5 to 8.
  - 3. Soluble-Salt Concentration: Less than 4 dS/m.
  - 4. Moisture Content: 35 to 55 percent by weight.
  - 5. Organic-Matter Content: 50 to 60 percent of dry weight.
  - 6. Particle Size: Minimum of 98 percent passing through a 1-inch sieve.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.
- C. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
- D. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

## 2.5 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

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- C. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.
- B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- C. Unsuitable Materials: Clean soil to contain a combined maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.
- D. Screening: Pass unamended soil through a 3-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 8 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
  - 1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth of 6 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.



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1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
    - a. Mix lime and sulfur with dry soil before mixing fertilizer.
    - b. Mix fertilizer with planting soil no more than seven days before planting.
  2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests:
1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D698. Space tests at no less than one for each 2000 sq. ft. of in-place soil or part thereof.
  2. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements. Perform testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
- C. Soil will be considered defective if it does not pass tests.
- D. Prepare test reports.
- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

### 3.5 PROTECTION

- A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Vehicle traffic.
  4. Foot traffic.
  5. Erection of sheds or structures.
  6. Impoundment of water.
  7. Excavation or other digging unless otherwise indicated.

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- B. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.6 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION

## SECTION 329200 - TURF AND GRASSES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Seeding.
  - 2. Hydroseeding.
  - 3. Sodding.
  - 4. Meadow grasses and wildflowers.

- B. Related Requirements:

- 1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

#### 1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" and drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- F. Partial Shade: An area of the site that receives more than four hours of sun each day during the growing season.

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- G. Shade: An area of the site that receives less than four hours of sun each day during the growing season.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  - 1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf and meadow establishment.
  - 1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or AmericanHort.
  - 2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
  - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  - 4. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

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- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
  - 1. Spring Planting: April 15-May 20.
  - 2. Fall Planting: August 15-October 1.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species:
  - 1. Quality, Non-State Certified: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
  - 2. Sun and Partial Shade, Cool-Season Grass: Proportioned by weight as follows:
    - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
    - b. 30 percent chewings red fescue (*Festuca rubra* variety).
    - c. 10 percent perennial ryegrass (*Lolium perenne*).
    - d. 10 percent redtop (*Agrostis alba*).
  - 3. Shade, Cool-Season Grass: Proportioned by weight as follows:

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- a. 50 percent chewings red fescue (*Festuca rubra* variety).
- b. 35 percent rough bluegrass (*Poa trivialis*).
- c. 15 percent redtop (*Agrostis alba*).

2.2 TURFGRASS SOD

- A. Turfgrass Sod: Complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
- B. Turfgrass Species, Cool-Season Grass: Sod of grass species as follows, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
  1. Sun and Partial Shade: Bluegrass/Fescue Mix.
  2. Shade: Tall Fescue.

2.3 MEADOW GRASSES AND WILDFLOWERS

- A. Wildflower and Native-Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:
  1. Type A: "New England Native Warm Season Grass Mix" by New England Wetland Plants ([www.newp.com](http://www.newp.com)).
  2. Type B: "New England Conservation/Wildlife Mix" by New England Wetland Plants ([www.newp.com](http://www.newp.com)).
- B. Seed Carrier: Inert material, sharp clean sand or perlite.

2.4 FERTILIZERS

- A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  1. Composition:
    - a. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.5 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.

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- C. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
  - 1. Organic Matter Content: 50 to 60 percent of dry weight.
  - 2. Feedstock: Agricultural, food, or industrial residuals; yard trimmings; or source-separated or compostable mixed solid waste.
- D. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- E. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- F. Asphalt Emulsion: ASTM D977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.6 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

### 3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
  - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
  - 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

### 3.3 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification)."
- B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.
  - 1. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.4 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
  - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
  - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
  - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft..
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.



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- E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
  - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
  - 2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

3.5 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, slow-release fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
  - 1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
  - 2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.6 SODDING

- A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
  - 1. Lay sod across slopes exceeding 1:3.
  - 2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.7 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

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1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
  2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
  3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
  2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
1. Mow Kentucky bluegrass, annual ryegrass, and chewings red fescue to a height of 1-1/2 to 2 inches.
  2. Mow turf-type tall fescue to a height of 2 to 3 inches.

3.8 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
  2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.9 MEADOW

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
1. Before sowing, mix seed with seed carrier at a ratio of not less than three parts seed carrier to one part seed.
  2. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

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3. Do not use wet seed or seed that is moldy or otherwise damaged.
- B. Sow seed at a total rate of 8 oz/1000 sq. ft.
- C. Brush seed into top 1/16 inch of soil, roll lightly, and water with fine spray.
- D. Water newly planted areas and keep moist until meadow is established.

3.10 MEADOW MAINTENANCE

- A. Maintain and establish meadow by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable meadow. Roll, regrade, and replant bare or eroded areas and remulch. Provide materials and installation the same as those used in the original installation.
  1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and meadow damaged or lost in areas of subsidence.
  2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
  3. Apply treatments as required to keep meadow and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and meadow-watering equipment to convey water from sources and to keep meadow uniformly moist.
  1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
  2. Water meadow with fine spray at a minimum rate of 1/2 inch per week for eight weeks after planting unless rainfall precipitation is adequate.

3.11 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.12 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

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- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

3.13 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
  - 1. Seeded Turf: 60 days from date of Substantial Completion.
    - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
  - 2. Sodded Turf: 30 days from date of Substantial Completion.
- B. Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Meadow Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable meadow is established, but for not less than maintenance period below.
  - 1. Maintenance Period: 40 days from date of Substantial Completion.

END OF SECTION

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SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plant materials.
2. Fertilizers.
3. Weed-control barriers.
4. Mulches.
5. Herbicides and pesticides.
6. Tree-stabilization materials.
7. Tree-watering devices.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting and hydroseeding.

1.2 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.3 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. Plant materials.
2. Fertilizers.
3. Mulches.
4. Herbicides and pesticides.
5. Tree-stabilization materials.
6. Tree-watering devices.

C. Product Data Submittals: For each product.

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1. Plant Materials: Include quantities, sizes, quality, and verified sources for plant materials.
- D. Samples for Verification: Actual sample of finished products for each of the following:
1. Organic Mulch: 1-pint volume of each organic mulch required; typical of the lot of material to be furnished, in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Provide an accurate representation of color, texture, and organic makeup.
  2. Mineral Mulch: 2 lb of each mineral mulch required; typical of the lot of material to be furnished, in sealed plastic bags labeled with source of mulch. Provide accurate indication of color, texture, and makeup.
  3. Weed-Control Barrier: 12 by 12 inches.
  4. Slow-Release, Tree-Watering Device: One unit of each size required.
  5. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Statements: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- C. Product Certificates: For each type of manufactured product, from manufacturer, and complying with manufacturer's certified analysis of standard products.
- D. Pesticides and Herbicides: Product label and manufacturer's written application instructions specific to Project.
- E. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
  1. Professional Membership: Member in good standing of either the National Association of Landscape Professionals or AmericanHort.
  2. Experience: Ten years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."

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3. Installer's Field Supervision: Maintain an experienced full-time supervisor on Project site when work is in progress.
  4. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.
- C. Measurements: Measure in accordance with ANSI Z60.1. Do not prune to obtain required sizes.
1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
  2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, or walkways and pavements; or on existing turf areas or plants.
  2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Deliver bare-root stock plants within 36 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.
- D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not

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bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

- E. Handle planting stock by root ball.
- F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
  - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
  - 1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
  - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
  - 3. Do not remove container-grown stock from containers before time of planting.
  - 4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
  - 1. Spring Planting: May 1-June 15.
  - 2. Fall Planting: August 30-October 1.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions in accordance with manufacturer's written instructions and warranty requirements.



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1.9 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
    - b. Structural failures, including plantings falling or blowing over.
    - c. Faulty performance of tree stabilization and edgings.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  2. Warranty Periods: From date of Substantial Completion.
    - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
    - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
  3. Include the following remedial actions as a minimum:
    - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
    - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
    - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; with tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); with crossing trunks; with cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
  2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

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- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare in accordance with ANSI Z60.1.
- D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for plant.
- E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to ensure symmetry in planting.
- F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but are not yet in bloom.

## 2.2 FERTILIZERS

- A. Granular Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  - 1. Composition:
    - a. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and maximum of 5.5 percent inert material.

## 2.3 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers inert to biological degradation and naturally resistant to chemicals, alkalis, and acids, formed into a stable network so that fibers retain their relative position.

## 2.4 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
  - 1. Type: Ground or shredded bark.
  - 2. Size Range: 3 inches maximum, 1/2 inch minimum.
  - 3. Color: Natural (Dark Brown).
- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

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1. Organic Matter Content: 50 to 60 percent of dry weight.
  2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:
1. Type: Rounded riverbed gravel or smooth-faced stone.
  2. Size Range: 1 inch minimum, 3 inch maximum.
  3. Color: To be selected by Architect from supplier's full color range.

## 2.5 HERBICIDES AND PESTICIDES

- A. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- B. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.
- C. Pesticides: Registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended in writing by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

## 2.6 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:
1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
  2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
  3. Guys and Tie Wires: ASTM A641/A641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
  4. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
  5. Guy Cables: Five-strand, 3/16-inch-diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.
  6. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

## 2.7 TREE-WATERING DEVICES

- A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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- a. [BIO-PLEX.](#)
- b. [Engineered Watering Solutions; PQ Partners, LLC.](#)
- c. [Spectrum Products, Inc.](#)
- d. Treegator.

2. Color: As selected by Architect from manufacturer's full range.

## 2.8 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix in accordance with manufacturer's written instructions.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
  1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
  3. Suspend planting operations during periods of excessive soil moisture until moisture content reaches acceptable levels to attain required results.
  4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove soil and contamination as directed by Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

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- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

### 3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil in accordance with Section 329115 "Soil Preparation (Performance Specification)."
- B. Placing Planting Soil: Place and mix planting soil in-place over exposed subgrade.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate in accordance with manufacturer's written instructions.

### 3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
  - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  - 2. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.
  - 3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
  - 4. Do not excavate deeper than depth of root ball, measured from the root flare to the bottom of root ball.
  - 5. If area under the plant was initially dug too deep, add soil to raise it to correct level and thoroughly tamp the added soil to prevent settling.
  - 6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  - 7. Maintain supervision of excavations during working hours.
  - 8. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
  - 9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

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- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

### 3.5 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball in accordance with ANSI Z60.1. If root flare is not visible, remove soil in a level manner from root ball to where the top-most root emerges from the trunk. After soil removal to expose root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
  - 1. Backfill: Planting soil. For trees, use excavated soil for backfill.
  - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - 4. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place in bottom of the hole.
    - a. Quantity: Three for each caliper inch of plant.
  - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
  - 1. Backfill: Planting soil. For trees, use excavated soil for backfill.
  - 2. Carefully remove root ball from container without damaging root ball or plant.
  - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - 4. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place in bottom of the hole.
  - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of root ball.

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3.6 MECHANIZED TREE-SPADE PLANTING

- A. Plant trees with approved mechanized tree spade at designated locations. Do not use tree spade to move trees larger than maximum size allowed for similar field-grown, balled-and-burlapped, root-ball diameter in accordance with ANSI Z60.1, or trees larger than manufacturer's maximum size recommendation for tree spade being used, whichever is smaller.
- B. Use same tree spade to excavate the planting hole as will be used to extract and transport the tree.
- C. When extracting tree, center the trunk within the tree spade and move tree with solid ball of earth.
- D. Cut exposed roots cleanly during transplanting operations.
- E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.
- F. Where possible, orient the tree in same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.
- C. Prune, thin, and shape trees, shrubs, and vines in accordance with standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.8 INSTALLATION OF TREE-STABILIZATION MATERIALS

- A. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Stake and guy trees more than 14 ft. in height and more than 3 inches in caliper unless otherwise indicated.
  - 1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.
    - a. Securely attach guys to stakes 30 inches long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.
    - b. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
    - c. Attach flags to each guy wire, 30 inches above finish grade.
    - d. Paint turnbuckles with luminescent white paint.

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2. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and in accordance with manufacturer's written instructions.

3.9 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 INSTALLATION OF MULCHES

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
  1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 24-inch radius around trunks or stems. Do not create a mulch cone or place mulch within 3 inches of trunks or stems.
  2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.11 INSTALLATION OF LANDSCAPE EDGINGS

- A. Shovel-Cut Edging: Separate mulched areas from turf areas, curbs, and paving with 45-degree, 4- to 6-inch-deep, shovel-cut edge as indicated on Drawings.
- B. Mow-Strip Installation:
  1. Excavate for mow strip.
  2. Compact subgrade uniformly beneath mow strip.
  3. Apply nonselective, pre-emergent herbicide that inhibits growth of grass and weeds.
  4. Install aluminum edging, delineating the edge of mow strip.
  5. Install weed-control barrier before mulching, covering area of mow strip, and overlapping and pinning edges of barrier at least 6 inches and in accordance with manufacturer's written instructions.



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6. Place indicated thickness of mineral mulch, fully covering weed barrier.
7. Rake mulch to uniform surface level with adjacent finish grades.

3.12 INSTALLATION OF TREE-WATERING DEVICES

- A. Provide one device for each tree.
- B. Place device on top of the mulch at base of tree stem and fill with water in accordance with manufacturer's written instructions.

3.13 APPLICATION OF HERBICIDES AND PESTICIDES

- A. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written instructions. Do not apply to seeded areas.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.
- C. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and in accordance with manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

3.14 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.15 REPAIR AND REPLACEMENT

- A. Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.
  1. Submit details of proposed pruning and repairs.
  2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
  3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

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- B. Remove and replace trees that are more than 25 percent dead or in unhealthy condition before end of corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
  - 1. Provide new trees of same size as those being replaced for each tree of 4 inches or smaller in caliper size.
  - 2. Provide one new tree(s) of 4-inch caliper size for each tree being replaced that measures more than 4 inches in caliper size.
  - 3. Species of Replacement Trees: Species selected by Architect.

3.16 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

END OF SECTION

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SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Piping joining materials.
2. Transition fittings.
3. Sleeves.
4. Grout.
5. Flowable fill.
6. Piped utility demolition.
7. Piping system common requirements.
8. Equipment installation common requirements.
9. Concrete bases.

1.2 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- C. ABS: Acrylonitrile-butadiene-styrene plastic.
- D. CPVC: Chlorinated polyvinyl chloride plastic.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

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- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.
- C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

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- b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
  - B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
  - C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
  - D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
  - E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
  - F. Solvent Cements for Joining Plastic Piping:
    - 1. PVC Piping: ASTM D2564. Include primer according to ASTM F656.
- 2.2 TRANSITION FITTINGS
- A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  - B. Transition Couplings NPS 1-1/2 (DN 40) and Smaller:
    - 1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
    - 2. Aboveground Piping: Specified piping system fitting.
  - C. AWWA Transition Couplings NPS 2 (DN 50) and Larger:
    - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - a. Cascade Waterworks Mfg. Co.
      - b. Dresser Utility Solutions.
      - c. Ford Meter Box Company, Inc. (The).
      - d. JCM Industries, Inc.
      - e. Smith-Blair, a Xylem brand.
      - f. Viking Johnson.
    - 2. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.
  - D. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:
    - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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- a. [Cascade Waterworks Mfg. Co.](#)
- b. [Fernco Inc.](#)
- c. [Mission Rubber Company, LLC.](#)
- d. [Plastic Oddities.](#)

2. Description: ASTM C1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

## 2.3 SLEEVES

- A. Mechanical sleeve seals for pipe penetrations are specified in Section 220500 "Common Work Results for Plumbing."
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
- D. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

## 2.4 GROUT

- A. Description: ASTM C1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## 2.5 FLOWABLE FILL

- A. Description: Low-strength-concrete, flowable-slurry mix.
  1. Cement: ASTM C150, Type I, portland.
  2. Density: 115- to 145-lb/cu. ft.
  3. Aggregates:
    - a. ASTM C33, natural sand, fine and crushed gravel or stone, coarse.
    - b. ASTM C33, natural sand, fine.
  4. Admixture: ASTM C618, fly-ash mineral.
  5. Water: Comply with ASTM C94/C94M.
  6. Strength: 100 to 200 psig at 28 days.

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PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

- A. Refer to Section 024119 "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 INSTALLATION OF PIPING

- A. Install piping according to the following requirements and utilities Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Sleeves are not required for core-drilled holes.
- J. Permanent sleeves are not required for holes formed by removable PE sleeves.
- K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

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1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 4 inches above finished floor level.
  2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
    - a. Pipe Sleeves: PVC. For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
- L. Verify final equipment locations for roughing-in.
- M. Refer to equipment specifications in other Sections for roughing-in requirements.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- E. Soldered Joints: Apply ASTM B813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B32.
- F. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. PVC Nonpressure Piping: Join according to ASTM D2855.
- G. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.
- H. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D3212.
- I. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.
1. Plain-End PE Pipe and Fittings: Use butt fusion.
  2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.



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3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.5 INSTALLATION OF EQUIPMENT

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 4000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.7 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.

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- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

## SECTION 331113 - GEOTHERMAL WELLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Rotary drilled geothermal wells.

B. Related Sections include the following:

1. Section 332113 "Ground-Loop Heat-Pump Piping" for installation of ground-loop piping and backfill.

#### 1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. PA: Polyamide (nylon) plastic.
- C. PE: Polyethylene plastic.
- D. PP: Polypropylene plastic.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: Submit certified performance curves and rated capacities of selected well pumps and furnished specialties and accessories for each type and size of well pump indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Field Quality-Control Reports:
  1. For each well pump, include the following:
    - a. Substrata formations.
    - b. Water-bearing formations.
    - c. Water levels.
- C. Well driller qualifications.

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1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For each well pump to include in emergency, operation, and maintenance manuals.
  - 1. Project Record Documents: Record the following data for each water supply well:
    - a. Casings: Material, diameter, thickness, weight per foot of length, and depth below grade.
    - b. Log: Formation log indicating strata encountered.
    - c. Alignment: Certification that well is aligned and plumb within specified tolerances.

1.6 QUALITY ASSURANCE

- A. Well Driller Qualifications: The water well shall be drilled by a State of Maine registered Well Driller in conformance with the State of Maine Drillers and Pump Installers Rules, 144A CMR 232. Well driller shall also have completed an International Ground Source Heat Pump Association certified ground-source seminar within the last 24 months.
- B. Testing Agency Qualifications: Certified by the EPA or State to analyze drinking water for compliance monitoring.

1.7 FIELD CONDITIONS

- A. Well Drilling Water: Provide temporary water and piping for drilling purposes. Provide necessary piping for water supply.

PART 2 - PRODUCTS

2.1 WELL CASINGS

- A. Steel Casing: AWWA C200, single ply, steel pipe with threaded ends and threaded couplings for threaded joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Pilot-Hole Data: Review pilot-hole test analysis furnished by Owner.
- B. Neighborhood Well Data: Review operating and test analyses.

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3.2 INSTALLATION OF WELLS

- A. Construct well using rotary drilling method.
- B. Take samples of substrata formation at 10-foot intervals and at changes in formation throughout entire depth of each water supply well. Carefully preserve samples on-site in glass jars properly labeled for identification.
- C. Excavate for mud pit or provide aboveground structure, acceptable to the Maine Department of Environmental Protection, to allow settlement of cuttings and circulation of drill fluids back to well without discharging to on-site waterways.
- D. Enlarge pilot hole and install permanent casing, screen, and grout. Install first section of casing with hardened steel driving shoe of an OD slightly larger than casing couplings if threaded couplings are used.
- E. Set casing and liners round, plumb, and true to line.
- F. Join casing pipe as follows:
  - 1. Ream ends of pipe and remove burrs.
  - 2. Remove scale, slag, dirt, and debris from inside and outside casing before installation.
  - 3. Cut bevel in ends of casing pipe and make threaded joints.
- G. Mix grout in proportions according to the grout manufacturer's written recommendations.
- H. Place grout continuously, from bottom to top surface, to ensure filling of annular space in one operation. Do not perform other operations in well within 72 hours after grouting of casing. When quick-setting cement is used, this period may be reduced to 24 hours.
- I. Provide permanent casing and well cap at depth indicated.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 332113 "Ground Loop Heat Pump Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.4 FIELD QUALITY CONTROL

- A. Test Preparation: Clean water supply wells of foreign substances. Swab casings using alkalis, if necessary, to remove foreign substances.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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1. Plumbness and Alignment Testing: Comply with AWWA A100.
2. Prepare reports on static level of ground water, level of water for various pumping rates, and depth to water-bearing strata.

E. Water supply well will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 PROTECTION

- A. Water Quality Protection: Prevent well contamination, including undesirable physical and chemical characteristics.
- B. Ensure that mud pit will not leak or overflow into streams or wetlands. When well is accepted, remove mud and solids in mud pit from Project site and restore site to finished grade.
- C. Protect wells to prevent tampering and introducing foreign matter. Retain temporary well cap until installation of ground loop piping is complete.

END OF SECTION

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SECTION 331415 - SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water-distribution piping and related components outside the building.

- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

- B. GAUD: Greater Augusta Utility District.

- C. LLDPE: Linear, low density polyethylene plastic.

- D. PE: Polyethylene plastic.

- E. PP: Polypropylene plastic.

1.3 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

- B. Product Data: For each type of product indicated.

- C. Shop Drawings: Line stopping valve. Show valve locator, anticipated excavation limits, work plan and manufacturer's written instructions.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

- B. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

- C. Field Quality-Control Submittals:

1. Field quality-control reports.

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1.5 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Operation and Maintenance Data: For each type of product indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare piping, valves, and fire hydrants according to the following:
  - 1. Ensure that piping, valves, and fire hydrants are dry and internally protected against rust and corrosion.
  - 2. Protect threaded ends and flange faces against damage.
  - 3. Set piping, valves, and fire hydrants in best position for handling and to prevent rattling.
- B. During Storage: Use precautions for piping, valves, and fire hydrants according to the following:
  - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle products if size requires handling by crane or lift. Rig products to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service in accordance with requirements indicated:
  - 1. Notify Architect and Owner no fewer than five business days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.



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1.8 COORDINATION

- A. Coordinate connection to water main with Owner.
- B. Content includes water-distribution piping and related components outside the building for domestic water service, fire-suppression water service, and service entrance piping to a point 1 ft. inside finished wall. Terminate water-service piping with appropriate fitting for extension by Divisions 21 and 22.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of GAUD. Include tapping of water mains and backflow prevention.
- B. Comply with standards of GAUD for domestic water-service piping, including materials, installation, testing, and disinfection.
- C. Comply with standards of GAUD having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
  - 1. Additional information is available in the Engineering section of the District's website (<https://www.greteraugustautilitydistrict.org/engineering>).
- D. Piping materials to bear label, stamp, or other markings of specified testing agency.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- F. Comply with ASTM F645 for selection, design, and installation of thermoplastic water piping.
- G. Comply with FM Approvals' "Approval Guide" and/or UL's "Fire Protection Equipment Directory" for fire-suppression water-service products.
- H. Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.
- I. NSF Compliance:
  - 1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
  - 2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.
  - 3. Connections to, and installation of, water main, shall be performed by a GAUD approved contractor.

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2.2 PIPING MATERIALS

- A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and service sizes.
- B. Potable-water piping and components comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type K.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- E. Cast-Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock-body, ball-and-socket, metal-to-metal seating surfaces; and solder-joint or threaded ends.

2.4 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated, with AWWA C104 double cement lining and seal coating.
  - 1. Interior seal coating: bituminous paint oil cut, emulsion not acceptable, with a minimum dry film thickness of 2 mils.
  - 2. Exterior seal coating: bituminous seal coating, with a minimum dry film thickness of 2 mils.
  - 3. Mechanical-Joint, Ductile-Iron Fittings: ASTM A536, grade 70-50-05, in accordance with AWWA C153, compact pattern, Class 350
    - a. Lining: AWWA C104 double cement lining or AWWA C550 and C116 fusion bonded epoxy coating with 5 mils nominal thickness.
    - b. Interior seal coating: AWWA C104 with a minimum dry film thickness of 4 mils.
    - c. Exterior seal coating: bituminous seal coating with a minimum dry film thickness of 4 mils or fusion bonded epoxy coated with a minimum nominal thickness of 5 mils per AWWA C550 and AWWA C116.
    - d. Fittings must provide adequate space for the mechanical joint and accessories to be installed without special tools (i.e. Lowell wrench can be used).
  - 4. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and High Strength/Low Alloy (Cor-Ten) steel bolts and nuts.

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2.5 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Deflection Fittings: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends.
  - 1. Manufacturers: Subject to compliance with GAUD requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. EBAA Iron Sales, Inc.
    - b. U.S. Pipe, a Forterra company.
  - 2. Source Limitations: Obtain ductile-iron deflection fittings from single manufacturer.
  - 3. Standards: AWWA C110 or AWWA C153/A21.53; AWWA C111/A21.11.
  - 4. Pressure Rating: 250 psig minimum.

2.6 PIPING JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.
- B. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.7 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
  - 1. Manufacturers: Subject to compliance with GAUD requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Cascade Waterworks Mfg. Co.
    - b. Ford Meter Box Company, Inc. (The).
    - c. JCM Industries, Inc.
    - d. Smith-Blair, a Xylem brand.
    - e. United Water Products.
  - 2. Source Limitations: Obtain tubular-sleeve pipe couplings from single manufacturer.
  - 3. Standard: AWWA C219.
  - 4. Center-Sleeve Material: Stainless steel or ductile iron.
  - 5. Gasket Material: Natural or synthetic rubber.
  - 6. Pressure Rating: 200 psig minimum.
  - 7. Coating:

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- a. Exterior: bituminous, 4 mils minimum thickness or fusion bonded epoxy, 5 mil nominal thickness per AWWA C550 and C116.
- b. Interior: bituminous, 4 mils minimum thickness.

2.8 ENCASEMENT FOR PIPING

- A. Standards: ASTM A674 or AWWA C105/A21.5.
- B. Form: Tube.
- C. Material: Linear low-density PE film of 0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch minimum thickness.
- D. Color: Black.

2.9 GATE VALVES

- A. AWWA, Nonrising-Stem, Resilient-Seated Gate valves:
  - 1. Manufacturers: Subject to compliance with GAUD requirements, provide one of the following:
    - a. AFC Series 2500.
    - b. US Metroseal Model 250
    - c. Clow Series 2638 C515.
  - 2. Description: GAUD approved valve with smooth unobstructed water way which shall be a minimum diameter of the valve.
    - a. Mounting position: Vertical
    - b. Open Direction: Clockwise (open-right)
    - c. Furnish valve with standard 2-inch AWWA operating nut color-coded (“red”) to valve opening.

2.10 CORPORATION VALVES

- A. Corporation Valve: Heavy duty, ball valve design with ground key plug and brass ball that is Teflon coated with Teflon seats that are water tight in each direction. The valve shall have a full port opening and a working pressure of 300 psi.
- B. Manufacturers:
  - 1. Manufacturers: Subject to compliance with GAUD requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Cambridge Brass.
    - c. Ford Meter Box Company, Inc. (The).
    - d. Mueller Co.

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- C. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
  - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
  - 2. Corporation valve: Heavy duty, ball valve design with ground key plug and brass ball that is Teflon coated with Teflon seats that are water tight in each direction. The valve shall have a full port opening and a working pressure of 300 psi.

2.11 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies: GAUD-approved sleeve and valve compatible with drilling machine.
  - 1. Standard: MSS SP-60.
  - 2. Tapping Sleeve: GAUD-approved ductile iron, mechanical joint, split sleeve with outlet flange conforming to AWWA C-110 Section 10-14 with drilling recessed for tapping valve.
  - 3. Valve: GAUD-approved AWWA, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.
    - a. Use manufacturer's recommended cutters based on valve size to prevent damage to the sealing surface.
  - 4. Maximum Working Pressure: 200psig
  - 5. Side rubber gaskets: rectangular in cross-section and fit into grooved channels in the casting. These gaskets shall extend the entire length of the sleeves and shall not require cutting or trimming to match mechanical joint end gaskets
  - 6. Pattern: AB-CD to permit use of plain rubber and duck-tipped gaskets for various outside diameter piping sizes.
  - 7. Type: Mechanical joint with Cor-Ten T-Bolts and nuts or approved equal
  - 8. Standard Accessories: Glands, gaskets for both ductile and oversized pit-cast pipe
  - 9. Flange outlet bolts: Type 304 Stainless Steel
  - 10. Coating: minimum 4 mil dry film thickness bituminous coating or fusion bonded epoxy coating on interior and exterior.
  - 11. Sleeve shall include ¾" FIPT test port and brass lug.
- B. Valve Box: two piece, heavy cast iron, complying with AWWA M44, free from defects.
  - 1. Minimum inside shaft diameter: 5 inches
  - 2. Bottom section: Slide-type with bell-type base and bottom lip, minimum 36 inches long. Provide products by the following manufacturer:
    - a. North American Manufacture.
  - 3. Top section: Slide-type, minimum 26 inches long, designed to slide over the bottom section. Provide products by the following manufacturer:
    - a. North American Manufacture.

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4. Valve box cover: heavy drop type to fit the opening of the top section. Provide cover with two pick holes for easy removal and the work “WATER” clearly cast into it. The rim of the cover must be solid, not fluted. Provide products by the following manufacturer:
  - a. Bingham & Taylor Standard Round Drop-in Lid 4905-L1.5.
  - b. Coating: Minimum 4 mils dry film thickness bituminous coating on interior and exterior of all components.
5. Valve Box Extension: Slide-type, designed to be able to accept a standard valve box cover. Provide products by the following manufacturer:
  - a. North American Manufacture.

2.12 LINE STOPPING VALVES

A. Insertion Valve:

1. Description: GAUD approved insertion resilient seated gate valve conforming to AWWA C509 capable of temporarily stopping flow within a water main without shutting off water supply to the main.
  - a. Layout: Capable of being rotated 120 degrees, perpendicular across the top of the pipe, while riding on three separate rubber gaskets, using a perpendicular rotary feed mechanism driven by a chain.
  - b. NPS 14 to 24:
    - 1) Maximum working pressure: 250 psi.
    - 2) Valve assembly construction: three piece, ASTM A536 65-45-12 ductile iron.
    - 3) Valve body coating: chip-resistant corrosion inhibiting coating and sealer, including internal and external threads.
    - 4) Bonnet and wrench nut: ASTM A536 65-45-12 ductile iron.
    - 5) Gate and resilient rubber seal: ASTM A536 65-45-12 ductile iron with ASTM 10429 rubber coating, expandable to the inside diameter of the pipe it is being inserted into.
    - 6) Bolts and nuts: ASTM A536 65-45-12 ductile iron with zinc alloy anodes for corrosion protection. Fasteners joining the valve bonnet to the valve top casting shall be stainless steel. The final restraint fasteners around the valve casting shall be stainless steel 304.
    - 7) Gaskets: EPDM.
    - 8) Valve Stem: Stainless steel 1 CR 12, with a minimum tensile strength of 60,000 psi.
    - 9) Set Collar: ASTM C519100 brass.
    - 10) Stem Nut: ASTM C90300 bronze.

B. Insertion valve manufacturer and model shall be approved by GAUD. Approved manufacturers include:

1. Advanced Valve Technologies, Inc; EZ valve.

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2.13 FIRE HYDRANTS

A. Fire Hydrants:

1. Description: GAUD-approved freestanding, traffic model with breakaway feature, with one NPS 4-1/2 and two NPS 2-1/2 outlets, drain valve (plugged), and NPS 6 mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
  - a. Standards: UL 246, FMG approved.
  - b. Working Pressure Rating: 250 psig minimum.
  - c. Retain four subparagraphs below with either "Description" Subparagraph retained above.
  - d. Outlet Threads: NFPA 1963, with external hose thread used by local fire department.
  - e. Port covers: supplied without chains and having the same size pentagon operator as the outlets.
  - f. Edit first two subparagraphs below if required by authorities having jurisdiction.
  - g. Operating and Cap Nuts: Pentagon, 1-5/8 inches point to flat.
  - h. Hydrant main valve: 5-1/4" valve opening
  - i. Hydrant shoe: 6" MJ. Seat and sub-seat shall both be bronze and horizontal and vertical blocking planes shall be manufactured into the hydrant base.
  - j. Direction of Opening: Open hydrant valve by turning operating nut to right or clockwise.
  - k. Bury Depth: 6-foot, 6 inch
  - l. Bolts and nuts:
    - 1) Buried mechanical joints: Cor-Ten or equal
    - 2) Flange joints: Type 304 stainless steel
  - m. Coatings: minimum 3 mils dry film thickness
    - 1) Internal area of hydrant base (normally exposed to water and includes the internal body of hydrant shoes, including lower valve plate): fusion-bonded epoxy coated.
    - 2) Internal and external cast or ductile-iron components: approved bituminous
    - 3) Upper barrel (exterior):
      - a) Surface preparation blast clean SSPC-SP-6
      - b) Prime coat: GAUD-approved color, 1.5 mils dry film thickness minimum.
      - c) Finish coat: GAUD-approved color, 1.5 mils dry film thickness of sufficient thickness to hide prime coat.
    - 4) Bonnet, operating nut and port cap:
      - a) Surface preparation blast clean SSPC-SP-6
      - b) Prime coat: Exterior primer, 1.5 mils dry film thickness minimum.
      - c) Finish coat: Exterior Aluminum, 1.5 mils dry film thickness of sufficient thickness to hide prime coat.

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- n. Flow Indicator Collar: provide space for flow indicator collar (to be installed by GAUD).
- o. Drain Hole: Plugged.
- p. Provide one of the following hydrants as required by GAUD:
  - 1) Waterous WB-67-250
  - 2) Clow Eddy F2641

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING APPLICATIONS

- A. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
- B. Do not use flanges or unions for underground piping, unless indicated on drawings.
- C. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- D. Underground water-service piping smaller than NPS 4 to be the following:
  - 1. Copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- E. Underground water- and fire-service piping NPS 4 and larger to be the following:
  - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM Global, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Underground Valves, NPS 3 and Larger: GAUD-approved AWWA, nonrising-stem, resilient-seated gate valves with valve box.



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2. Underground Valves, NPS 3 and Smaller: GAUD-approved AWWA corporation valve with valve box.

### 3.4 PIPING SYSTEMS – COMMON REQUIREMENTS

- A. Comply with Section 330500 “Common Work Results for Utilities” for piping-system common requirements.

### 3.5 INSTALLATION OF PIPING

- A. Water-Main Connection:

1. Tap water main in accordance with requirements of GAUD and of size and in location indicated.

- B. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve in accordance with MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

- C. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

- D. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install PE corrosion-protection encasement in accordance with ASTM A674 or AWWA C105/A21.5.
2. Install copper tube and fittings in accordance with CDA's "Copper Tube Handbook."

- E. Install ductile-iron, water-service piping in accordance with AWWA C600 and AWWA M41.

1. Install PE corrosion-protection encasement in accordance with ASTM A674 or AWWA C105/A21.5.

- F. Bury piping with depth of cover over top at least 72 inches.

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- G. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- H. Extend water-service piping and connect to water-supply source and building water-piping systems at outside face of building wall in locations and pipe sizes indicated.
  - 1. Terminate water-service piping at building wall until building water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water-piping systems when those systems are installed.
- I. Sleeves and mechanical sleeve seals are specified in Section 210517 "Sleeves and Sleeve Seals for Fire Suppression Piping" and Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- J. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire Suppression Piping" and Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- K. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- L. Comply with Section 211000 "Water-Based Fire-Suppression Systems" for fire-suppression-water piping inside the building.
- M. Comply with Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.6 JOINT CONSTRUCTION

- A. Comply with Section 330500 "Common Work Results for Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:
  - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
  - 2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
  - 3. Copper Pipe: Solder or brazed joints.
  - 4. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
    - a. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

3.7 INSTALLATION OF ANCHORAGE

- A. Anchorage: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
  - 1. Concrete thrust blocks.
  - 2. Locking mechanical joints.
  - 3. Set-screw mechanical retainer glands.
  - 4. Pipe clamps and tie rods.

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- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
  - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: In accordance with AWWA C600.
  - 2. Fire-Service-Main Piping: In accordance with NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 INSTALLATION OF VALVES

- A. AWWA Gate Valves: Comply with GAUD requirements, AWWA C600, and AWWA M44. Install each underground valve with stem pointing up and with valve box.

3.9 LINE STOPPING VALVE INSTALLATION

- A. Install insertion valve in accordance with manufacturer's written recommendations. Coordinate installation with GAUD and provide at least 48 hours' notice prior to performing the work.

3.10 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Comply with GAUD requirements.
- C. AWWA Fire Hydrants: Comply with AWWA M17.

3.11 CONNECTIONS

- A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.
- B. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve.
- C. Connect water-distribution piping to interior domestic water and fire-suppression piping.
- D. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.12 FIELD QUALITY CONTROL

- A. Testing and inspection must comply with GAUD requirements.
- B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

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- C. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
  - 1. Increase pressure in 50 psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- D. Prepare reports of testing activities.

3.13 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.14 CLEANING

- A. Cleaning and disinfection procedures must comply with GAUD requirements.
- B. Clean and disinfect water-distribution piping as follows:
  - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by GAUD or, if method is not prescribed by GAUD, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
  - 3. Use purging and disinfecting procedure prescribed by GAUD or, if method is not prescribed by GAUD, use procedure described in AWWA C651 or do as follows:
    - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
    - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    - d. Submit water samples in sterile bottles to GAUD. Repeat procedure if biological examination shows evidence of contamination.
- C. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 332113 - GROUND-LOOP HEAT-PUMP PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes and fittings.
2. Borehole backfill.
3. Antifreeze solution.
4. Accessories.

B. Related Sections include the following:

1. Section 232113 "Hydronic Piping" for geothermal-water piping inside the building and bypass chemical feeder.
2. Section 331113 "Geothermal Wells" for geothermal well installation and borehole backfill

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data: For each type of product.

1. Pipes and fittings.
2. Joining method and equipment.
3. Borehole backfill.
4. Propylene-glycol solution.

1.3 INFORMATIONAL SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Field Quality-Control Reports:

1. Piping tests.
2. Hydrostatic tests.
3. Antifreeze solution testing report.

C. Well completion report.

D. Dimensioned site layout.

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- E. Startup performance results.

## PART 2 - PRODUCTS

### 2.1 PIPES AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Centennial Plastics, Inc.
  - 2. Chevron-Phillips Chemical Company; Performance Pipe Division.
  - 3. Versaprofiles.
  - 4. WL Plastics.
- B. HDPE Pipe: ASTM F2619/F2619M.
- C. Molded HDPE Fittings: ASTM D2683 or ASTM D3261, ASTM F1055 PE resin, socket, butt-fusion or electro-fusion type, made to match HDPE pipe dimensions and class.
- D. U-Bend Assembly: Factory fabricated with embossed depth stamp every 24 inches from U-bend.
- E. Ground-Loop, Heat-Pump Piping Minimum Working Pressure: 200 psig.
- F. Ground-Loop, Heat-Pump Piping Operating Temperature: Between 23 and 104 deg F.

### 2.2 BOREHOLE BACKFILL

- A. Description: Thermally enhanced bentonite-sand grout mixture specifically intended for use in closed-loop geothermal well systems.
- B. Seal Material: Bentonite clay with thermal conductivity greater than 1.07 Btu/h x sq. ft. x deg F in accordance with ASTM D5334.
- C. Permeability: Not more than 1 nm/s in accordance with ASTM D5084.
- D. Solids percentage: 63.5% minimum. The thermal enhancement compound (high-grade silica compound) shall constitute a minimum of 50% by weight of the aqueous slurry.
- E. Grouting materials shall be pre-manufactured and pre-packaged prior to delivery to the site.

### 2.3 ANTIFREEZE SOLUTION

- A. Inhibited Propylene Glycol:
  - 1. Propylene glycol with inhibitor additive, to provide freeze protection for heat-transfer fluid and corrosion protection for carbon steel, brass, copper, stainless steel, and cast-iron piping and fittings.

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2. Inhibitor creates a passive layer on all surfaces that contact propylene glycol to prevent corrosion and stabilizes fluid pH, to compensate for acids formed from glycol degradation.
3. pH value maintained between 9.5 – 10.5, with reserve alkalinity greater than 15.0 mL.
4. Concentrated inhibited propylene glycol is to be 94 percent propylene glycol by weight and 6 percent performance additives.
5. Concentrated inhibited propylene glycol is mixed with water in proper proportion specified by manufacturer to provide freeze protection to minus 20 deg F. Premixed heat-transfer fluid may be used, or glycol/water mixture may be prepared at the time of installation. Use only deionized water for mixing.
6. Provide only propylene glycol that is specifically blended for HVAC application. Automotive-type antifreeze is unacceptable.

## 2.4 ACCESSORIES

- A. Detectable Warning Tape: As specified in Section 312000 "Earth Moving."

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavating, trenching, warning tape, and backfilling are specified in Section 312000 "Earth Moving."
- B. Do not enclose, cover, or put horizontal below grade piping into operation prior to obtaining a sign-off on the review of the installation by both Mechanical Contractor, the Owner, and the Architect for coordination purposes. Provide 48 hours notice of backfilling operations to Mechanical Contractor, Owner and Architect for review purposes.

### 3.2 INSTALLATION OF HORIZONTAL PIPING

- A. Remove rocks in trenches that could contact pipe.
- B. Install HDPE piping in trenches in accordance with ASTM D2774 or ASTM F645.
  1. Clean HDPE pipe and fittings and make heat-fusion joints in accordance with ASTM D2657. Minimize number of joints.
- C. Install the header piping and the horizontal piping from the header to the distribution piping at depth indicated.
- D. Provide rigid insulation between supply and return piping and horizontal rigid insulation over supply and return piping as indicated.
- E. Extend the horizontal piping and connect to ground-loop heat-pump piping systems at outside face of building wall in locations and pipe sizes indicated.

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1. Terminate piping at building wall until building ground-loop heat-pump piping systems are installed. Terminate piping with caps. Make connections to building ground-loop heat-pump piping systems when those systems are installed.
- F. Purge, flush, and pressure test all piping before backfilling trenches.
  1. Pressure test piping in accordance with ASTM F2164.
- G. Backfill all horizontal piping and header trenches.
  1. Install sand in trench and all around pipe to protect pipe from damage by sharply edged rocks and similar material.
  2. Install continuous detectable underground warning tape prior to backfilling of trenches for underground piping. Locate tape a minimum of 24 inches below finished grade, directly over piping.
- H. Seal penetrations through building walls.
- I. Wall sleeves are specified in Section 230500 "Common Work Results for HVAC."
- J. Mechanical sleeve seals are specified in Section 230500 "Common Work Results for HVAC."

### 3.3 INSTALLATION OF VERTICAL PIPING

- A. Install HDPE piping in boreholes in accordance with ASTM D2774 or ASTM F645.
  1. Clean HDPE pipe and fittings and make heat-fusion joints in accordance with ASTM D2657. Minimize number of joints.
  2. Provide factory fabricated U-bend assembly at base of vertical piping.
- B. Purge, flush, and pressure test all piping before backfilling boreholes.
  1. Pressure test in accordance with ASTM F2164.
- C. After installation of loop pipe in borehole, fill piping loop with water or antifreeze solution, and pump bentonite backfill into borehole to at least 72 inches below grade.
- D. Completely fill the borehole from bottom to top with Bentonite backfill material.

### 3.4 ANTIFREEZE SOLUTION FILL

- A. Fill system with required quantity of propylene glycol and water to provide minus 20 deg F freezing temperature.
- B. Test dilute solution using gas chromatography to verify concentration of propylene glycol.
- C. Maintain records of system testing on-site. Submit report to Architect and Owner.



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3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.6 FIELD QUALITY CONTROL

- A. Piping Tests: Fill piping 24 hours before testing and apply test pressure to stabilize piping. Use potable water only.
- B. Hydrostatic Tests: Test at not less than one and one-half times the pipe working pressure and temperature rating specified above.
  - 1. Test for piping system leaks in accordance with ASTM F2164.
  - 2. Increase pressure in 50 psig increments and inspect each joint between increments. Hold at test pressure for 30 minutes. Slowly increase to next test pressure increment and hold for 30 minutes. After testing at maximum test pressure, reduce pressure to 30 psig. Hold for 90 minutes, and measure pressure at 30-minute intervals. Repair leaks and retest until no leaks exist.
  - 3. Maintain a minimum pipe velocity of 24 in./s for a minimum of 15 minutes to remove all air.
- C. Prepare test and inspection reports.

END OF SECTION

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SECTION 334200 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. PE pipe and fittings.
  - 2. PVC pipe and fittings.
  - 3. Non-pressure transition couplings.
  - 4. Butterfly valves.
  - 5. Manholes.
  - 6. Plastic, channel drainage systems.
  - 7. Catch basins.
  - 8. Pipe outlets.
  - 9. Stormwater treatment and disposal systems.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. MPBS: Modular plastic box storage.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 “Submittal Procedures” and the individual sections specifying the work.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
  - 1. **Product Data:** For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- D. Shop Drawings:
  - 1. Manholes, catch basins, and channel drainage systems: Include plans, elevations, sections, details, frames, and cover grates.

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2. Stormwater treatment and disposal systems: Include plans, elevations, sections, details, frames, and covers.
3. Tree Box Filters: Include plans, elevations, section and details.

E. Modular Plastic Box Storage System:

1. Submit proposed MPBS layout drawings. Drawings shall include typical section details as well as the required base elevation of stone and tanks, minimum cover requirements and tank configuration.
2. Manufacturer's installation instructions and product data, including compressive strength and unit weight.
3. Submit MPBS sample for review. Reviewed and accepted samples will be returned to the Contractor.
4. Submit required experience and personnel requirements as specified in herein.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Operation and Maintenance Data: For all stormwater disposal systems, including chambers and modular plastic box storage system.

1.7 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. All materials shall be manufactured in ISO certified facilities.
- C. MBPS Installation Contractor shall demonstrate the following experience:
  1. A minimum of three MPBS or equivalent projects completed in Maine within 2 years; and,
  2. A minimum of 25,000 cubic feet of storage volume completed within 2 years.
  3. Contractor experience requirement may be waived if the manufacturer's representative provides on-site training and review during construction.

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- D. Installation Personnel: Performed only by skilled workers with satisfactory record of performance on bulk earthworks, pipe, chamber, or pond/landfill construction projects of comparable size and quality.
- E. At the Owner's request, have MPBS manufacturer's representative available for site review.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes in accordance with manufacturer's written rigging instructions.
- D. Handle catch basins in accordance with manufacturer's written rigging instructions.
- E. Handle tree box filters in accordance with manufacturer's written rigging instructions.
- F. Protect MPBS and other materials from damage during delivery, and store UV sensitive materials under tarp to protect from sunlight when time from delivery to installation exceeds one week. Storage of materials should be on smooth surfaces, free from dirt, mud and debris.
  - 1. Handling is to be performed with equipment appropriate to the materials and site conditions, and may include hand, handcart, forklifts, extension lifts, etc.
  - 2. Cold weather:
    - a. Care must be taken when handling plastics when air temperature is 40 degrees or below as plastic becomes brittle.
    - b. Do not use frozen materials or materials mixed or coated with ice or frost.
    - c. Do not build on frozen ground or wet, saturated or muddy subgrade.

1.9 FIELD CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
  - 1. Notify Architect and Owner no fewer than five business days in advance of proposed interruption of service.
  - 2. Submit plan for review by the Architect demonstrating how the interruption will not cause upstream flooding.
  - 3. Do not proceed with interruption of service without Owner's written permission.
- B. Coordinate installation for the MPBS system with other on-site activities to eliminate all non-installation related construction traffic over the completed MPBS system. No loads heavier than the design loads shall be allowed over the system, and in no case shall loads higher than a standard AASHTO HS20 load be allowed on the system at any time.
- C. Protect adjacent work from damage during MPBS system installation.

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- D. All pre-treatment systems to remove debris and heavy sediments must be in place and functional prior to operation of the MPBS system. Additional pretreatment measures may be needed if unit is operational during construction due to increased sediment loads.
- E. Contractor is responsible for any damage to the system during construction.

PART 2 - PRODUCTS

2.1 CORRUGATED-PE PIPE AND FITTINGS

- A. Source Limitations: Obtain corrugated-PE pipe and fittings from single manufacturer.
- B. Corrugated-PE Drainage Pipe and Fittings NPS 6 to NPS 10: AASHTO M 252, Type S, with smooth waterway for coupling joints.
- C. Corrugated-PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294, Type S, with smooth waterway for coupling joints.
- D. Corrugated-PE Silttight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
- E. Perforated PE Pipe and Fittings NPS 12 to NPS 36: AASHTO M 294, Type SP, with smooth waterway for coupling joints.
  - 1. Silttight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

2.2 PVC PIPE AND FITTINGS

- A. PVC Type PSM Sewer Piping:
  - 1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
  - 2. Fittings: ASTM D3034, PVC with bell ends.
  - 3. Gaskets: ASTM F477, elastomeric seals.
- B. Adhesive Primer: ASTM F656.
  - 1. Verify adhesive primer complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

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B. Sleeve Materials:

1. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
2. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work included, but are not limited to, the following:
  - a. Dallas Specialty & mfg. Co.
  - b. Fernco Inc.
  - c. Logan Clay Pipe.
  - d. Mission Rubber Company, LLC, a division of MCP Industries.
  - e. NDS Inc.
  - f. Plastic Oddities.
2. Source Limitations: Obtain unshielded, flexible couplings from single manufacturer.
3. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work included, but are not limited to, the following:
  - a. Cascade Waterworks Mfg. Co.
  - b. Dallas Specialty & mfg. Co.
  - c. Mission Rubber Company, LLC, a division of MCP Industries.
2. Source Limitations: Obtain shielded, flexible couplings from single manufacturer.
3. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work included, but are not limited to, the following:
  - a. Fernco Inc.
  - b. Logan Clay Pipe.
  - c. Mission Rubber Company, LLC, a division of MCP Industries.
2. Source Limitations: Obtain ring-type, flexible couplings from single manufacturer.
3. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

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2.4 BUTTERFLY VALVES

- A. PVC Butterfly Valve: As indicated.

2.5 DRAINS

- A. Drain Basins:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work included, but are not limited to, the following:
  - a. ADS Inc.
2. Source Limitations: Obtain area drains from single manufacturer.
3. Description: One-piece PVC round body with anchor flange and round grate. Include bottom outlet with stud joint connection conforming to ASTM D3212 for corrugated PE pipe and PVC pipe, of sizes indicated.
4. Frames, Grates, and Solid Covers: Ductile iron conforming to ASTM A536, Grade 70-50-05.
5. Top-Loading Classification(s): AASHTO H-20.

2.6 MANHOLES

- A. Standard Precast Concrete Manholes:

1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Base Section: 6-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
4. Riser Sections: 5-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C990, bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
9. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

- B. Manhole Frames and Covers:

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1. Description: City of Augusta Standard, ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "DRAIN."
2. Material: ASTM A48/A48M, Class 35 gray iron unless otherwise indicated.

2.7 CONCRETE

- A. General: Cast-in-place concrete in accordance with ACI 318, ACI 350, and the following:
  1. Cement: ASTM C150/C150M, Type II.
  2. Fine Aggregate: ASTM C33/C33M, sand.
  3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
  4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
  1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
  2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

2.8 POLYMER-CONCRETE, CHANNEL DRAINAGE SYSTEMS

- A. Narrow, Sloped-Invert, Polymer-Concrete Channel Drainage Systems:
  1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work included, but are not limited to, the following:
    - a. ABT, Inc.
    - b. ACO USA.
    - c. Forte Composites, Inc.
    - d. Jay R. Smith Mfg. Co.
    - e. Josam Company.
    - f. Polycast: Hubbell Powr Systems, Inc.
  2. Source Limitations: Obtain from single manufacturer.
  3. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
  4. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps.
    - a. Include rounded bottom, with built-in invert slope of 0.5 percent and with outlets in number, sizes, and locations indicated.
    - b. Include extension sections necessary for required depth.
    - c. Dimensions: 4-inch inside width. Include number of units required to form total lengths indicated.
    - d. Frame: Manufacturer's standard for grade selected.
  5. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.



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- a. Material: Stainless steel.
6. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
7. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

## 2.9 CATCH BASINS

### A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 5-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C990, bitumen or butyl rubber.
6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
7. Grade Rings: Include two or three reinforced-concrete rings, of 4- to 9-inch total thickness, that match 24-inch-diameter frame and grate.
8. Steps: ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
9. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

### B. Square Frames and Grates: City of Augusta Standard, ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.
3. Pedestrian and bicycle safe.

### C. Round Frames and Grates: City of Augusta Standard, ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange, and 26-inch-diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.
2. Pedestrian and bicycle safe.

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2.10 STORMWATER TREATMENT AND DISPOSAL SYSTEMS

A. Chamber Systems:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Advanced Drainage Systems, Inc.
  - b. CULTEC, Inc.
  - c. Hancor Inc.
  - d. Infiltrator Systems Inc.
  - e. StormTech LLC.
2. Storage and Leaching Chambers: Molded PE with perforated sides and open bottom. Include number of chambers, distribution piping, end plates, and other standard components as required for system total capacity.
3. Filtering Material: As indicated.
4. Filter Mat: Geotextile woven or spun filter fabric, in one or more layers, for minimum total unit weight of 4 oz./sq. yd.

B. Modular Plastic Box Storage System

1. MPBS - Injection molded plastic tank plates assembled to form a 95% void modular structure of predesigned height indicated on drawings, with the following physical and chemical characteristics:
  - a. Rating: Traffic, AASHTO HS-20
  - b. Material: Polypropylene
  - c. Void area: 95%
  - d. Surface Void Area: 90%
  - e. Compressive Strength: ASTM D2412, ASTM F2418, 33.4 psi
  - f. Minimum Cover: 2 feet
  - g. Maximum Cover: 7 feet
  - h. Unit Weight: 3.62 pcf
  - i. Rib Thickness: 0.18 inches
  - j. Service Temperature: -14 to 167° F
2. Basis-of-Design Product: Subject to above requirements and the requirements of the State of Maine Department of Environmental Protection, provide R-Tank HD by Ferguson Waterworks/ACF Environmental or approved equal. Any proposed equal alternative product substitution to this specification must be submitted for review and approved prior to bid opening to confirm compliance with Maine DEP regulations. Review package should include third party reviewed performance data that meets or exceeds criteria specified herein.

C. Tree Box Filter:

1. Self-contained precast vault with open sides and bottom containing flow-through bioretention system.
2. Basis-of-Design Product: Subject to above requirements and the requirements of the State of Maine Department of Environmental Protection, provide StormTree System or approved equal. Any proposed equal alternative product substitution to this specification

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must be submitted for review and approved prior to bid opening to confirm compliance with Maine DEP regulations. Review package should include third party reviewed performance data that meets or exceeds criteria specified herein.

2.11 MISCELLANEOUS MATERIALS

A. Inspection Port:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Rain Bird.
2. Description: 8-inch to 10-inch diameter round valve box with a body made of structural foam HDPE resin.

B. Anti-Seep Collars: 1/16-inch gum rubber with wood frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Agri-Drain Corp.

2.12 PIPE OUTLETS

A. NPS 10 and Larger: PE flares end section.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Gravity-flow, non-pressure storm drain piping:
1. NPS 4 to NPS 8: PVC sewer pipe and fittings.
  2. NPS 10 and larger: Corrugated PE drainage pipe and fittings.

3.2 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

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- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure drainage piping in accordance with the following:
  - 1. Install piping pitched down in direction of flow.
  - 2. Install PE corrugated sewer piping in accordance with ASTM D2321.
  - 3. Install PVC sewer piping in accordance with ASTM D2321 and ASTM F1668.

### 3.4 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping in accordance with the following:
  - 1. Join corrugated-PE piping in accordance with ASTM D3212 for push-on joints.
  - 2. Join PVC sewer piping in accordance with ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasketed joints.
  - 3. Join dissimilar pipe materials with nonpressure-type flexible couplings.

### 3.5 BUTTERFLY VALVE INSTALLATION

- A. Install horizontal-type butterfly valves in piping where indicated.
- B. Install combination horizontal and manual butterfly valve type in piping and in manholes where indicated.
- C. Install terminal-type butterfly valves on end of piping and in manholes where indicated.

### 3.6 DRAIN BASIN INSTALLATION

- A. Install type of drain basins in locations indicated.
- B. Embed drains in 4-inch-minimum concrete around bottom and sides where indicated.
- C. Fasten grates to drains if indicated.
- D. Set drain frames and covers with tops flush with pavement surface.
- E. Backfill in accordance with manufacturer's requirements.

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3.7 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants in accordance with ASTM C891.
- C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 2 inches above finished surface elsewhere unless otherwise indicated.

3.8 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.9 STORMWATER INLET/OUTLET INSTALLATION

- A. Install flared end sections in accordance with manufacturer's requirements, at located indicated.
- B. Construct riprap of broken stone, as indicated.

3.10 STORMWATER TREATMENT AND DISPOSAL SYSTEM INSTALLATION

- A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.
- B. Modular Plastic Box Storage system: Excavate trench of width and depth and install system and backfill according to manufacturer's written recommendations, including chambers, filtering material, and filter mat.
- C. Tree Box Filters: Install in accordance with manufacturer's written recommendations. Coordinate timing of connections and commissioning with manufacturer.

3.11 ANTI-SEEP COLLAR INSTALLATION

- A. Install in accordance with manufacturer's written instructions.

3.12 CONCRETE PLACEMENT

- A. Place cast-in-place concrete in accordance with ACI 318.

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3.13 CHANNEL DRAINAGE SYSTEM INSTALLATION

- A. Install in accordance with manufacturer's requirements.
- B. Install with top surfaces of components, except piping, flush with finished surface.
- C. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
- D. Embed channel sections and drainage specialties in concrete around bottom and sides, as recommended by manufacturer.
- E. Fasten grates to channel sections in accordance with manufacturer's requirements.
- F. Assemble channel sections with flanged or interlocking joints.

3.14 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Facility Storm Drainage Piping."
- B. Make connections to existing piping and underground manholes.
  - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
  - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
  - 3. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
  - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
    - a. Unshielded or shielded flexible couplings for same or minor difference OD pipes, as indicated.
    - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

### 3.15 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
  - 1. Provide temporary plug and fill with flowable intended to be used for filling piping. Remove plug once flowable fill has fully cured.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
  - 1. Remove manhole or structure and close open ends of remaining piping.
  - 2. Break up bottom of structure to ensure it will not retain water.
  - 3. Remove top of manhole or structure down to at least 48 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade in accordance with Section 312000 "Earth Moving."

### 3.16 IDENTIFICATION

- A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
  - 1. Use detectable warning tape over piping and over edges of underground structures.

### 3.17 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

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1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems in accordance with requirements of authorities having jurisdiction.
  3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  4. Submit separate report for each test.
  5. Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
    - b. Option: Test plastic piping in accordance with ASTM F1417.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.18 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION



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SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Perforated-wall pipe and fittings.
2. Geotextile filter fabrics.
3. Cleanouts.

1.2 ACTION SUBMITTALS

A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.

B. Product Data:

1. Perforated wall pipe and fittings.
2. Geotextile filter fabrics.
3. Cleanouts.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:

1. NPS 6 and Smaller: AASHTO M 252, Type SP; corrugated, smooth interior, for coupled joints.
  - a. Perforation Dimensions: 7/8 inches tall by 1/8 inches wide.
2. Couplings: Manufacturer's standard, band type.

B. Perforated PVC Sewer Pipe and Fittings: ASTM D2729, bell-and-spigot ends, for loose joints.

- a. Perforation Dimensions: 1/4 inch diameter.

2.2 SOIL MATERIALS

A. Soil materials are specified in Section 312000 "Earth Moving."

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2.3 GEOTEXTILE FILTER FABRICS

- A. Geotextile filter fabric is specified in Section 31 20 00 "Earth Moving."

2.4 CLEANOUTS

- A. PVC Cleanouts: ASTM D3034, SDR-35 pipe, threaded pipe and threaded pipe hub with heavy-duty, H-20 loading class cast-iron cover.

PART 3 - EXECUTION

3.1 SUBDRAINAGE PIPING APPLICATIONS

- A. Foundation Drainage and areas where underdrains are indicated: Perforated PVC, ASTM D 3034, SDR 35
- B. Stormwater Treatment Areas only unless specifically indicated otherwise: AASHTO M 252, Type SP, corrugated smooth interior.

3.2 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.4 FOUNDATION DRAINAGE INSTALLATION

- A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- B. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- C. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.
- D. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

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- E. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.
- F. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- G. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.
- H. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

### 3.5 UNDERSLAB DRAINAGE INSTALLATION

- A. Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 6 inches between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- D. Install drainage piping as indicated in Part 3 "Piping Installation" Article for underslab subdrainage.
- E. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.
- F. After satisfactory testing, cover drainage piping with drainage course to elevation of bottom of slab, and compact and wrap top of drainage course with flat-style geotextile filter fabric.

### 3.6 RETAINING-WALL DRAINAGE INSTALLATION

- A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- B. Place supporting layer of drainage course over compacted subgrade to compacted depth of not less than 4 inches.
- C. Install drainage piping as indicated in Part 3 "Piping Installation" Article for retaining-wall subdrainage.
- D. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.
- E. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.

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- F. Place drainage course in layers not exceeding 3 inches in loose depth; compact each layer placed and wrap top of drainage course with flat-style geotextile filter fabric.
- G. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.
- H. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.7 LANDSCAPING DRAINAGE INSTALLATION

- A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches between conduit and trench walls.
- E. Add drainage course to top of drainage conduits.
- F. After satisfactory testing, cover drainage conduit to within 12 inches of finish grade.
- G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.
- I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.8 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions and other requirements indicated.
  - 1. Foundation Subdrainage: Install piping to the elevations indicated.
  - 2. Underslab Subdrainage: Install piping to the elevations indicated.
  - 3. Retaining-Wall Subdrainage: Install piping to the elevations indicated.
  - 4. Landscaping Subdrainage: Install piping to the elevations indicated.
  - 5. Lay perforated pipe with perforations down.
  - 6. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

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- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- C. Install thermoplastic piping in accordance with ASTM D2321.

3.9 PIPE JOINT CONSTRUCTION

- A. Join perforated PE pipe and fittings with couplings in accordance with ASTM D3212 with loose banded, coupled, or push-on joints.
- B. Join perforated PVC sewer pipe and fittings in accordance with ASTM D3212 with loose bell-and-spigot, push-on joints.
- C. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.10 CLEANOUT INSTALLATION

- A. Comply with requirements for cleanouts specified in Section 33 41 00 "Storm Utility Drainage Piping."
- B. Cleanouts for Foundation Subdrainage:
  - 1. Install cleanouts from piping to grade. Locate cleanouts where indicated. Install fittings so cleanouts open in direction of flow in piping.
  - 2. In vehicular-traffic areas, use NPS 4 PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 8 inches deep. Set top of cleanout flush with grade.
  - 3. In nonvehicular-traffic areas, use NPS 4 PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set top of cleanout 1 inch above grade.
  - 4. Comply with requirements for concrete specified in Section 03 30 00 "Cast-in-Place Concrete."

3.11 CONNECTIONS

- A. Comply with requirements for piping specified in Section 334100 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.

3.12 IDENTIFICATION

- A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Section 312000 "Earth Moving."
  - 1. Install detectable warning tape over nonferrous piping and over edges of underground structures.

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3.13 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

B. Drain piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.14 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION

SECTION 334713 - POND AND RESERVOIR LINERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes geomembrane liners for ponds and reservoirs fabricated from the following:
  - 1. Polyvinyl chloride (PVC).
- B. Related Requirements:
  - 1. Section 312000 "Earth Moving" for excavating, compacting, and grading the subgrade; for excavating and backfilling the anchor trench; for protecting the earthwork; for removing ground water from subgrade to the extent required by liner manufacturer; for adding requirements for the earth cover; and for the filter fabric and other geotextiles.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, and accessories for geomembrane liners.
- C. Shop Drawings: Include panel layout, seams, penetrations, perimeter anchorage, and methods of attachment and sealing to other construction. Differentiate between factory and field seams and joints.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Qualification Data: For Installer.

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- C. Product Certificates: For each type of geomembrane liner.
- D. Product Test Reports: For each geomembrane sheet, for tests performed by a qualified testing agency.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Submittals shall comply with the requirements of Section 013300 "Submittal Procedures" and the individual sections specifying the work.
- B. Maintenance Data: For geomembrane liner to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace geomembrane liner that fail(s) in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Leaks in geomembrane liner.
    - b. Defects in seams.
    - c. Cracks and holes in floating cover.
  - 2. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain geomembrane liner, accessories, and required seaming materials, solvents, and adhesives from single source.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide geomembrane liners that prevent the passage of water.



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2.3 PVC SHEET MATERIALS

- A. PVC Sheet: Formulated from virgin PVC with plasticizers and other modifiers, compounded for use in hydraulic structures, and formed into uniform, flexible non-reinforced sheets with material properties complying with ASTM D7176 and FGI 1120, "Specification for New PVC Geomembranes," for nominal thickness indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Environmental Protection, Inc.
    - b. Solmax International Inc.
    - c. Watersaver Company, Inc.
  - 2. Nominal Thickness: 30 mils.
  - 3. Sheet Texture: One side smooth; other side smooth.

2.4 MISCELLANEOUS MATERIALS

- A. Adhesives: Provide types of adhesive primers, compounds, solvents, and tapes recommended in writing by geomembrane liner manufacturer for bonding to structures (if required), for sealing of seams in geomembrane liner, and for sealing penetrations through geomembrane liner.
- B. Penetration Assemblies: Provide manufacturer's standard factory-fabricated assemblies for sealing penetrations. Include joint sealant recommended in writing by geomembrane liner manufacturer and compatible with geomembrane liner, containment conditions, and materials.

2.5 FABRICATION

- A. Fabricate geomembrane liner panels from sheets in sizes as large as possible with factory-sealed seams, consistent with limitations of weight and installation procedures. Minimize field seaming.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for soil compaction and grading; for subgrade free from angular rocks, rubble, roots, vegetation, debris, voids, protrusions, and ground water; and for other conditions affecting performance of geomembrane liner.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Provide temporary ballast, until edges are permanently secured, that does not damage geomembrane liner or substrate, to prevent uplift of geomembrane liner in areas with prevailing winds.
- B. Prepare surfaces of construction penetrating through geomembrane liner according to geomembrane liner manufacturer's written instructions.

3.3 INSTALLATION

- A. General: Place geomembrane liner over prepared surfaces to ensure minimum handling. Install according to Shop Drawings and in compliance with geomembrane liner manufacturer's written instructions. Begin placing geomembrane liner at Project's upwind direction and proceed downwind. Install geomembrane liner in a relaxed condition, free from stress and with minimum wrinkles, and in full contact with subgrade. Do not bridge over voids or low areas in the subgrade. Fit closely and seal around inlets, outlets, and other projections through geomembrane liner. Permanently secure edges.
- B. Field Seams: Comply with geomembrane liner manufacturer's written instructions. Form seams by lapping edges of panels 2 to 4 inches, unless instructions require a larger overlap. Wipe contact surfaces clean and free of dirt, dust, moisture, and other foreign materials. Use solvent-cleaning methods and grind geomembrane seam surfaces if recommended by geomembrane liner manufacturer. Proceed with seaming at required temperatures for materials and ambient conditions. Continuously bond sheet to sheet to construct single or double seams of width recommended for method of seaming used. Seal or fuse free seam edges. Inspect seams and reseal voids.
  - 1. Thermal Bonding: Use thermal-welding technique recommended by geomembrane liner manufacturer. Apply pressure to smoothly bond surfaces together. Examine for and patch wrinkles and fishmouths.
- C. Liner Repairs: Repair tears, punctures, and other imperfections in geomembrane liner field and seams using patches of geomembrane liner material, liner-to-liner bonding materials, and bonding methods according to geomembrane liner manufacturer's written instructions. Apply bonding solvent or weld to contact surfaces of both patch and geomembrane liner, and press together immediately. Roll to remove wrinkles.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Nondestructive Testing: Visually inspect seams and patches. Comply with ASTM D4437 for Air Lance Test, Vacuum Box Testing, or Ultrasonic (High Frequency) Pulse Echo Testing or with GRI Test Method GM6, as applicable to geomembrane liner and seam construction. Record locations of failed seams and patches. Individually number and date occurrences and details of leak and remedial action. Repair leaking seams and patches.
- C. Prepare test and inspection reports.

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3.5 PROTECTION

- A. Protect installed geomembrane liner according to manufacturer's written instructions. Repair or replace areas of geomembrane liner damaged by scuffing, punctures, traffic, rough subgrade, or other unacceptable conditions.
- B. Before placement of materials over geomembrane liner, inspect seams and patched areas to ensure tight, continuously bonded installation. Repair damaged geomembrane liner and seams and reinspect repaired work.

END OF SECTION

