DASCHLAGER HOUSE

RENOVATION

Augusta, Maine

BGS Project No. 3560

Architect Project No. 2022147

PROJECT MANUAL



ARTIFEX
architects & engineers

February 17, 2026

DOCUMENT 000101 - PROJECT TITLE PAGE

1.1 PROJECT MANUAL

Daschlager House Renovation
Bureau of General Services
Augusta, Maine.

Architect Project No. 2022147

BGS Project # 3560

Artifex AE, LLC
175 Exchange Street
Bangor, Maine 04401
Phone: (207) 974-3028
Website: artifexae.com.

Issued: August 4, 2025

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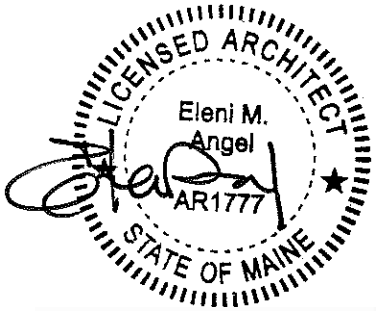
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DOCUMENT 00 01 07 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

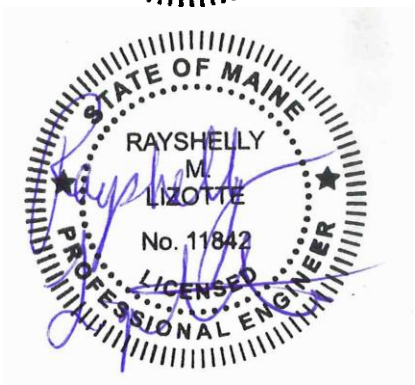
A. Architect:

1. **Ellen Angel /Artifex AE**.
2. **ME AR 1777**
3. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.



B. Civil Engineer:

1. Rayshelly Lizotte /Artifex AE
2. ME PE 11842
3. Responsible for Divisions 31, 32, and 33 as included

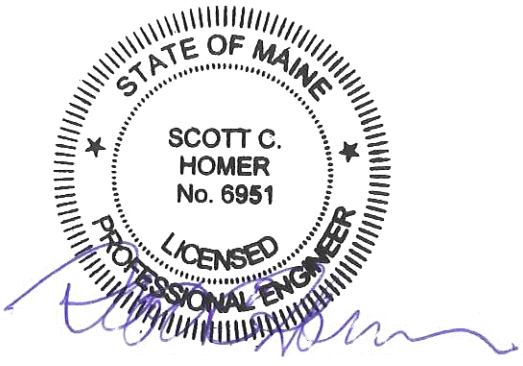


C. Landscape Architect:

1. Samuel Coplon, FASLA

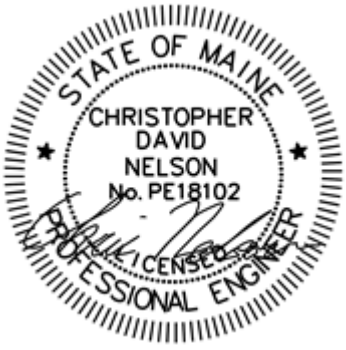
D. Structural Engineer:

1. Scott C. Homer
2. ME PE 6951
3. Responsible for 03 30 00; 03 45 00; 05 12 00; 05 21 00; 05 21 13; 05 31 00; 05 40 00; 05 50 00; 06 10 53.



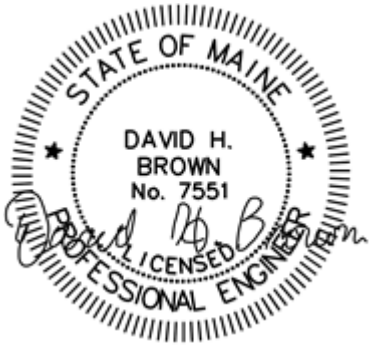
E. Fire-Protection Engineer:

1. Christopher David Nelson
2. ME PE 18102
3. Responsible for Division 21 as included.



F. Plumbing Engineer:

1. David H. Brown
2. ME PE 7551
3. Responsible for Division 22 as included.



G. HVAC Engineer:

1. David H. Brown
2. ME PE 7551
3. Responsible for Division 23 as included.

H. Electrical Engineer:

1. Jay T. Westra
2. ME PE 13509
3. Responsible for Division 26 as included.



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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.

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.

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.

DOCUMENT 00 31 26 - EXISTING HAZARDOUS MATERIAL INFORMATION

1.1 EXISTING HAZARDOUS MATERIAL INFORMATION

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for 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 but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. An existing Hazardous Material Assessment, prepared by Haley Ward Inc., is available for viewing as appended to this Document.
   1. The assessment for the Daschlager House, dated May 28, 2024, identifies lead-containing surfaces on the interior and exterior of the building, as well as various materials of potential Universal Waste or Hazardous Waste.

C. Related Requirements:

   1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.

END OF DOCUMENT 00 31 26

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

HAZARDOUS MATERIALS ASSESSMENT

FOR

DASCHLAGER HOUSE
BGS 3560
55 CAPITOL STREET
AUGUSTA, MAINE

Property Owner: State of Maine

Prepared For: Bureau of General Services
111 Sewall Street, 77 SHS, 4th Floor
Augusta, Maine 04333

MAY 28, 2024
JN: 10377.040

Report Prepared By:
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HALEYWARD.COM

EXECUTIVE SUMMARY

Haley Ward, Inc. (Haley Ward) completed a Hazardous Materials Assessment (HMA) to identify and assess hazardous materials on or within the Daschlager House (BGS 3560) located at 55 Capitol Street in Augusta, Maine (the Site) on May 7, 2024.

This assessment was completed to identify and assess Asbestos-Containing Materials (ACM), Lead-Based Paint (LBP)/lead-containing surface coatings, and potential hazardous materials/wastes and Universal Wastes, present on the interior and exterior of the building which would require special handling and disposal or would be regulated prior to, or during, planned renovations or demolition of the structure.

The Daschlager House is a three-story, masonry structure with a full basement and a pitched asphalt roof system. The building currently houses offices, a reception area, restrooms, a conference room, work room, library, and storage rooms on the first through third floors. The basement consists of an archaeology lab with storage, a wet lab, file room, general storage areas, and mechanical space.

The following is a summary of findings by sampled or observed medium:

ACM

Laboratory analysis of sampled suspect ACM, did not identify sampled materials as asbestos-containing.

LBP/Lead-Containing Surface Coatings

LBP/lead-containing surface coatings were identified on the interior and exterior of the building and range in condition from good to poor.

Potential Hazardous Materials/Wastes and Universal Wastes

Potential Universal Waste and/or Hazardous Wastes or materials identified on the interior and exterior of the building included:

- Fluorescent light bulbs
- Polychlorinated Biphenyl (PCB)-containing light ballasts
- Mercury-containing thermostats
- Emergency exit signs
- Emergency light batteries

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APPENDICES

Appendix A Asbestos and Lead-Based Paint Risk Assessor Certifications

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Appendix D Lead-Based Paint Determination

Appendix E Photographic Log

1.0 INTRODUCTION

Haley Ward, Inc. (Haley Ward) completed a Hazardous Materials Assessment (HMA) to identify and assess hazardous materials on or within the Daschlager House located at 55 Capitol Street, in Augusta, Maine (the Site) on May 7, 2024.

This assessment was completed to identify and assess Asbestos-Containing Materials (ACM), Lead-Based Paint (LBP)/lead-containing surface coatings, and potential hazardous materials/wastes and Universal Wastes present on the interior and exterior of the building, which would require special handling and disposal or would be regulated prior to, or during, the planned renovations or demolition of the structure.

The Daschlager House, constructed circa 1840, is a three-story, masonry structure with a full basement and a pitched asphalt roof system. The building currently houses offices, a reception area, restrooms, a conference room, work room, library, and storage rooms on the first through third floors. The basement consists of an archaeology lab with storage, a wet lab, file room, general storage areas and mechanical space.

2.0 ASBESTOS CONTAINING MATERIALS

2.1 Asbestos Identification Survey

An asbestos identification survey was conducted in accordance with the Maine Department of Environmental Protection (MDEP) Asbestos Management Regulations (06-096 C.M.R. Chapter 425, 2011) to provide information regarding the presence of ACM within the interior and on the exterior of the Daschlager House. Ms. Deborah Kasik, a MDEP licensed asbestos inspector, completed the field survey. A copy of Ms. Kasik's asbestos inspector licenses/certifications are included in **Appendix A**.

Completion of the asbestos identification survey included:

- Visual identification of suspect ACM on the interior and/or exterior of the building.
- Collection of 45 bulk samples of suspect ACM in accordance with MDEP regulations.
- Quantification of ACM identified by laboratory analysis.

As with any scientific study, an asbestos identification survey is subject to a variety of limitations. Limitations to be considered when interpreting the results of the survey performed at the building included:

- An asbestos identification survey may not be able to identify all ACM present throughout a facility.
- Variations in building materials used during construction and subsequent renovations.
- Inaccessible units, rooms, areas within wall cavities, under floors, and above solid ceilings.

- A visual assessment of the existing asphalt shingle roof system on the Daschlager House was performed by Haley Ward as part of the assessment of hazardous materials. The asphalt shingle roof system appeared intact and was, therefore, not sampled.

A total of forty-five (45) samples of identified suspect ACM were collected from the interior and/or exterior of the building, including:

- Gypsum wall board (GWB) wall and ceiling material
- Plaster wall and ceiling material
- Refractory cement
- Wallboard material attached to staircase frame
- Masonry skim coat
- Two types of floor tiles and associated floor tile adhesives
- One type of ceiling tile
- Carpet adhesive
- Textured ceiling material
- Exterior window glazing
- Exterior caulk around window systems
- Foundation skim coat
- Asphalt felt beneath clapboard siding

The number of samples collected was determined by the number of homogeneous sampling areas identified by the inspector. A homogeneous area is an area which, based on the inspector's judgment, contains materials that are uniform in color and texture and are present on similar building or utility components.

Bulk samples of suspect ACM collected during the survey of the building were submitted to EMSL Analytical, Inc. (EMSL) of South Portland, Maine, for analysis. Bulk samples were analyzed using the MDEP required analytical methods: "PLM-EPA 600/R-93/116" (for surfacing, thermal system insulation, and cementitious materials) and "PLM NOB-EPA 600/R-93/116" (for non-friable organically bound materials (NOBs)) (e.g., floor tile, adhesives, and roofing) with "gravimetric reduction." EMSL's laboratory is certified to perform asbestos analysis by both the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Industrial Hygiene Association (AIHA). EMSL is a MDEP licensed Asbestos Analytical Laboratory. Copies of EMSL's laboratory certifications are included as **Appendix B**.

Sample numbers and locations are indicated on **Figures H-101 and H102**. Laboratory analytical results and chain of custodies are included as **Appendix C**.

2.2 Asbestos Sampling Results

According to MDEP regulations, locations and occurrences of materials that tested positive and are homogenous in nature (similar in color and texture) are considered to be ACM, provided the material contains greater than or equal to (≥) one percent (%)

asbestos, based on laboratory analysis. A material can only be considered negative for asbestos if analytical results from all bulk samples in a group of samples representing that material indicate an asbestos content of less than (<) one percent.

Laboratory analytical results did <u>not</u> identify the sampled suspect materials as asbestos-containing.

3.0 LEAD-BASED PAINT/LEAD-CONTAINING SURFACE COATING DETERMINATION

An LBP/lead-containing surface coating determination was conducted by Ms. Deborah A. Kasik, a MDEP certified Lead Risk Assessor. A copy of Ms. Kasik's Lead Risk Assessor certification is included in **Appendix A**. The purpose of the determination was to identify LBP/lead-containing surface coatings, if present, on the interior and exterior surfaces of the building. The LBP determination was performed in accordance with the established protocols outlined in the MDEP Lead Management Regulation (06-096 C.M.R. Chapter 424 § 7, 2021) and as applicable to this project. The testing provides information on the lead content, and an assessment of the condition of the surfaces tested.

The LBP/lead-containing surface coating determination was conducted using a portable X-Ray Fluorescence (XRF) Lead Paint Analyzer (RMD LPA-1), which non-destructively tests for the presence of LBP or other lead-containing surface coatings. The XRF analyzer is licensed with the Maine Department of Human Services Radiation Control Program and operated in accordance with all applicable regulations and conditions of licensure. The determination as to whether a component contains lead is based upon the MDEP Lead Management Regulations (Chapter 424) which defines a component as lead-containing if the XRF result is ≥ 1.0 milligrams per square centimeter (mg/cm^2). A visual assessment of the existing condition of the identified LBP was also completed at the time of the determination.

XRF testing is non-destructive and, therefore, limitations exist when interpreting the results including:

- The XRF readings are for the specific coating/component tested; and
- Building components that were inaccessible at the time of the inspections (e.g., areas above solid ceilings, multiple wall systems, covered components, and upper trim) were not tested.

Haley Ward did not make any significant assumptions while conducting the LBP determination.

Calibration of the equipment is required by regulation prior to LBP testing, after every four hours of testing, and at the completion of the testing. Calibration readings were within the manufacturer's recommended range. Field calibration was performed throughout the day to ensure the integrity of the readings for the project.

LBP/lead-containing surface coatings were identified on interior and exterior surfaces of the building and range in condition from good to poor.

A summary of XRF Results is presented in **Table 1** below. A photographic log is included as **Appendix E**.

TABLE 1: CLASSIFICATION OF COMPILED XRF RESULTS – INTERIOR AND EXTERIOR

INTERIOR BUILDING COMPONENTS	COMPILED XRF READING CLASSIFICATION
INTERIOR:	
Ceilings (drywall, plaster)	Negative, Positive
Ceiling (tin; First Floor)	Positive
Walls (drywall)	Negative
Walls and Associated Trim (plaster)	Positive
Walls (brick)	Negative
Walls (wood; basement unused stairway)	Positive
Support Columns (wood, metal, brick)	Negative
Doors (wood and metal; basement)	Negative
Door Trim (wood and metal; basement)	Negative
Basement Window Sashes	Negative
Floor (concrete)	Negative
Stair Treads and Risers (wood; unused basement stairs)	Positive
Stair Stringer (wood; unused basement stairs)	Positive
Stair Treads and Risers (wood; to exterior from basement)	Negative
Baseboards (wood; basement)	Negative
Piping (basement)	Negative
Fireplace Trim	Positive
Fireplace Brick	Negative
Window Sashes	Positive
Window Trim	Positive
Window Sashes and Trim (First; Conference Room)	Negative
Stair Treads, Risers, Newell Post, Balusters (wood; 1st to 2nd floor)	Positive
Stair Sideboard (wood; 2nd to 3rd Floor)	Positive
Closet Floor (wood; 2nd Floor)	Positive
Closet Walls (plaster)	Negative
Closet Piping (metal)	Negative
Chimney Plaster	Positive
Door and Trim(wood)	Positive

INTERIOR BUILDING COMPONENTS	COMPILED XRF READING CLASSIFICATION
EXTERIOR:	
Siding (brick)	Negative
Siding (wood clapboard; front and rear middle section)	Positive
Upper Trim (wood; includes all types)	Assume Positive
Door and Associated Door Trim (wood)	Positive
Window Sashes	Positive
Window Trim (wood; includes all associated trim)	Positive
Window Trim (wood; decorative upper trim and lower panels)	Positive
Window Shutters (wood)	Positive

A negative classification indicates that lead is not present on the components/ associated components at or above the MDEP standard of 1.0 mg/cm^2. A negative XRF result is any value less than the lower bound of the inconclusive range, defined as 0.7 mg/cm^2 in Edition No. 5 of the RMD Performance Characteristic Sheet.

4.0 POTENTIAL UNIVERSAL WASTE AND POTENTIAL HAZARDOUS MATERIALS/WASTES

Haley Ward evaluated the building for the presence of potential Universal Wastes and/or Hazardous Wastes or materials. An inventory of identified materials and associated budgetary cost estimate for removal and disposal are presented in **Table 2**.

TABLE 2 | POTENTIAL HAZARDOUS MATERIALS INVENTORY

Potential Hazardous Materials	Quantity (Each)	Quantity Per Unit	Total Estimated Quantity	Unit Cost	Estimated Remediation Cost
Fluorescent Light Tubes – 4 foot	160	4 LF/EA	640 LF	$0.30	$192
Suspect Polychlorinated Biphenyl (PCB)-Containing Light Ballasts (EA)	67	1 EA	67 EA	$4	$268
Mercury-containing thermostats	3	1 EA	3 EA	$4	$12
Exit Light Signs/Batteries	2	1 EA	2 EA	$4	$8
Emergency Light Batteries	3	1 EA	3 EA	$4	$12
Sub-Total A					**$492**
Transportation (per pickup)	1		-	$1,250	$1,250
Labor (man days)	2		-	$650	$1,300
Sub-Total B					**$2,550**
				TOTAL	**$3,042**

When removed for disposal, fluorescent light bulbs are considered a Universal Waste and must be properly handled, packaged, and disposed of under current MDEP Universal Waste Rules, 06-096 C.M.R. Chapter 858 (2018).

Potential hazardous materials in the form of PCB-containing light ballasts were observed within the structure. When removed for disposal, light ballasts contain capacitors that may be filled with PCB-containing dielectric fluid; however, it is unknown whether PCB ballasts (also a Universal Waste) are present in the building. The recommended best management practice is to individually remove each light fixture and have individual ballasts evaluated to confirm the presence or absence of PCBs. Non-PCB light ballasts will be clearly labeled as not containing PCBs and may be disposed of as solid waste. If no such labeling is present, the ballasts should be treated as PCB-containing and should be segregated and handled as Universal Waste. Leaking PCB-containing ballasts should be segregated and handled as hazardous waste.

Mercury-containing thermostats, emergency exit signs, and emergency light batteries should be removed and recycled or disposed of as required.

5.0 CONCLUSIONS

This investigation revealed the following relevant information:

ACM

Laboratory analysis of sampled suspect ACM did not identify sampled materials as asbestos-containing.

Lead-Based Paint/Lead-Containing Surface Coatings

LBP/lead-containing surface coatings were identified on the interior and exterior of the building. The condition of the observed paint coatings ranged from good to poor.

Potential Universal and/or Hazardous Wastes or materials.

Potential Universal Waste and/or Hazardous Wastes or materials identified on the interior and exterior of the building included:

- Fluorescent light bulbs
- PCB-containing light ballasts
- Mercury-containing thermostats
- Emergency exit signs
- Emergency light batteries

6.0 REPORT CERTIFICATION

This report was prepared and reviewed by Haley Ward for the use of the Bureau of General Services and should not be reproduced without their full, written authorization.

Deborah A. Kasik
Project Scientist II
MDEP Certified Asbestos Inspector License No. AI-0177
MDEP Certified Lead Risk Assessor License No. LR-0003

Michael D. Sauda, MPH, CSP
Senior Project Manager

DAK/MDS
Attachments

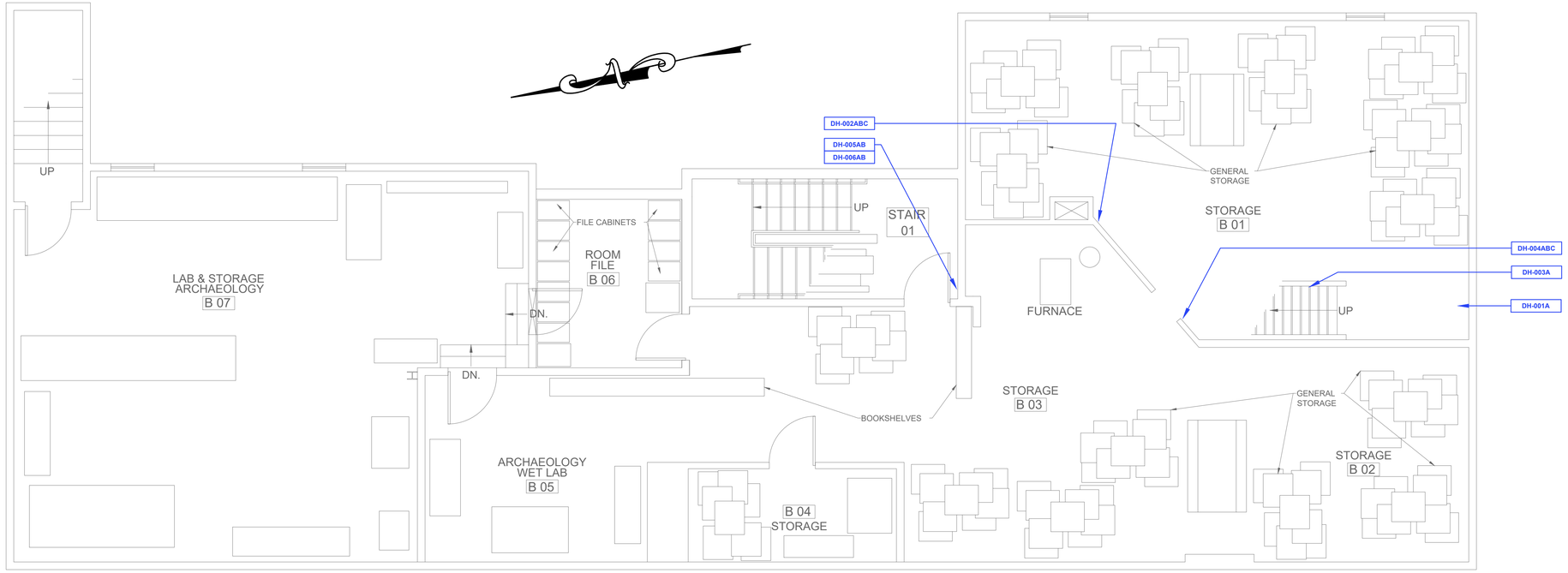
FIGURES

PLAN REFERENCE:

FLOOR PLAN DERIVED FROM DRAWINGS BY OTHERS PROVIDED TO HALEY WARD, INC AND ARE NOT WARRANTED AS TO ACCURACY AND ARE INTENDED TO BE SCHEMATIC.

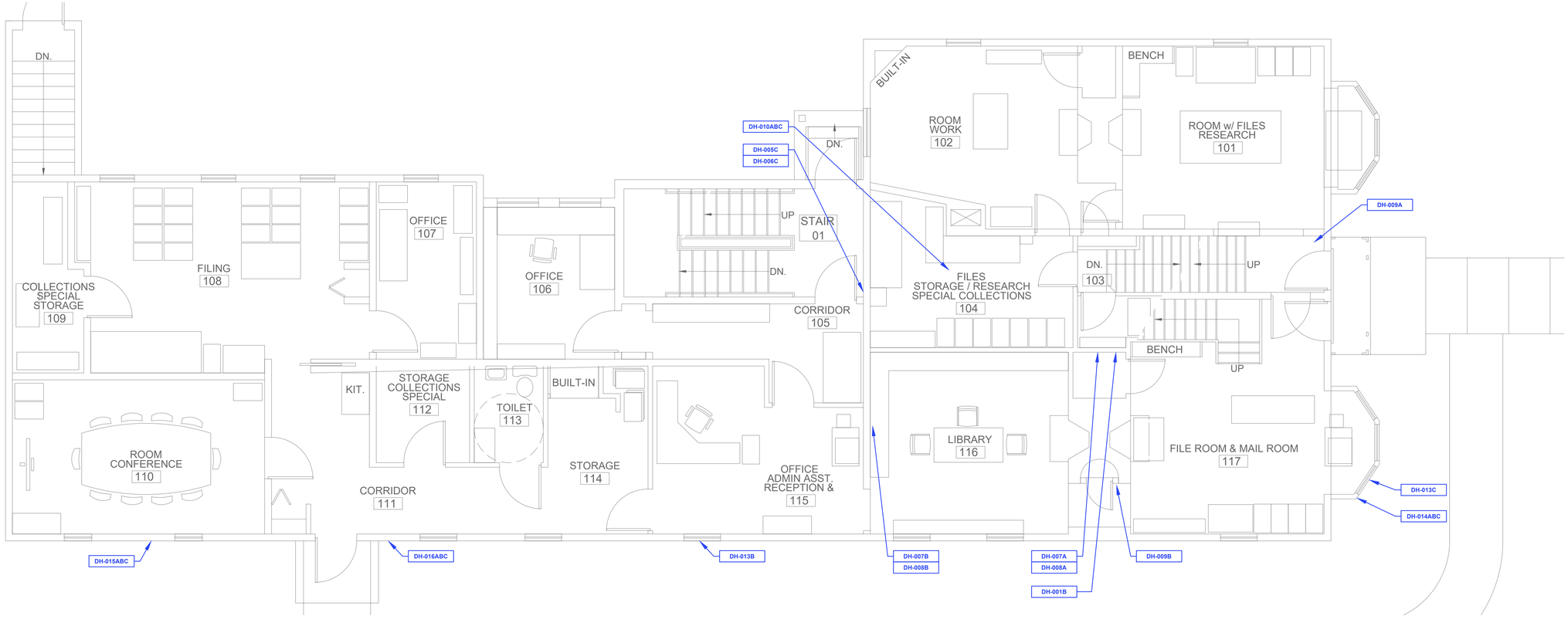
ASBESTOS LEGEND

DH-002A — **SAMPLE NUMBER AND LOCATION TESTING NEGATIVE FOR ASBESTOS**



BASEMENT PLAN

SCALE: NOT TO SCALE



GROUND FLOOR

SCALE: NOT TO SCALE

REV.	DATE	DESCRIPTION	BY	CHK.

DRAWING ISSUE STATUS

NOT FOR CONSTRUCTION

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING
WWW.HALEYWARD.COM
One Merchants Plaza, Suite 701
Bangor, Maine 04401
207.989.4824

PROJECT

Daschlager House
(BGS3560)
55 Capital St. Augusta. Me 04330

TITLE

BASEMENT & GROUND FLOOR PLAN HAZARDOUS MATERIAL ASSESSMENT

DATE	SCALE
2024.05.23	AS NOTED

DRAWN BY	DESIGNED BY	CHECKED BY
MEB	DAK	DAK

PROJECT No. 10377.040

DRAWING No. **H101** REV.

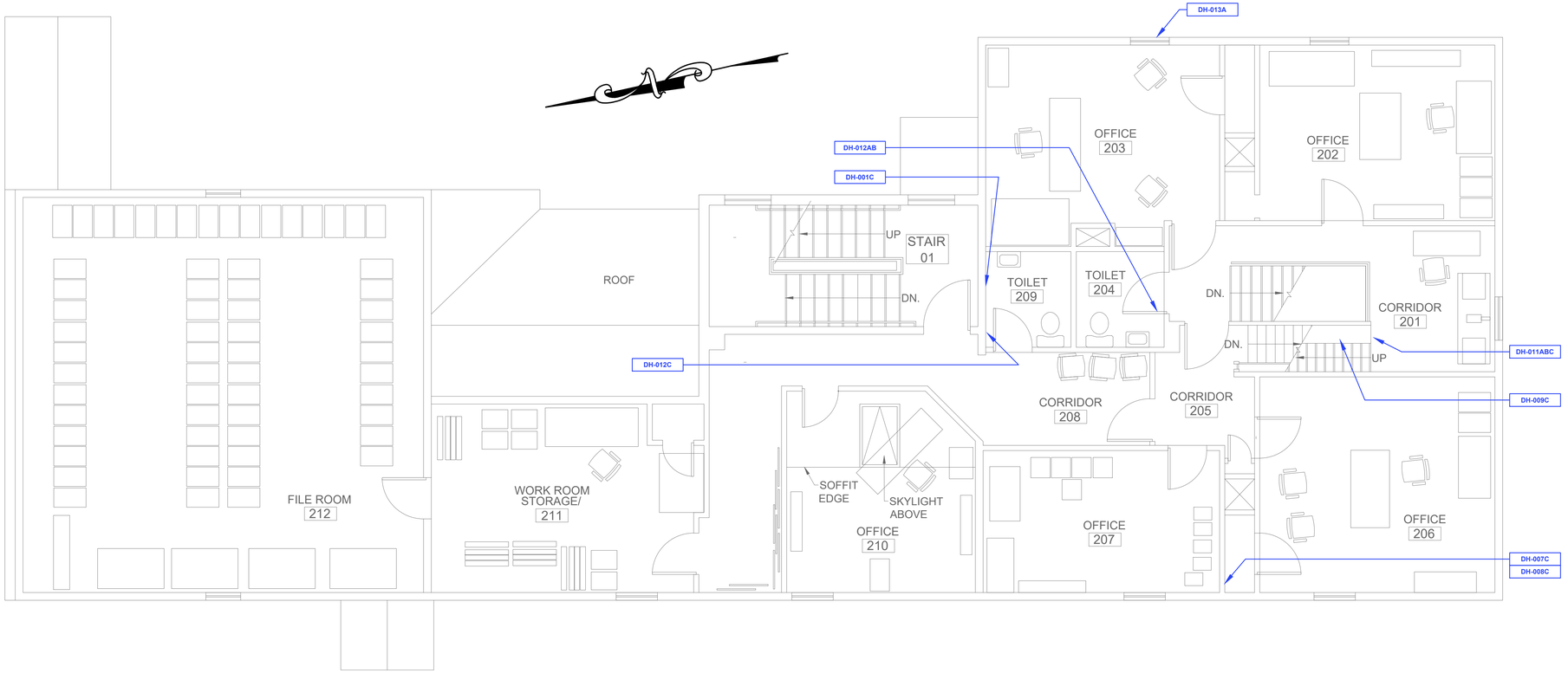
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PLAN REFERENCE:

FLOOR PLAN DERIVED FROM DRAWINGS BY OTHERS PROVIDED TO HALEY WARD, INC AND ARE NOT WARRANTED AS TO ACCURACY AND ARE INTENDED TO BE SCHEMATIC.

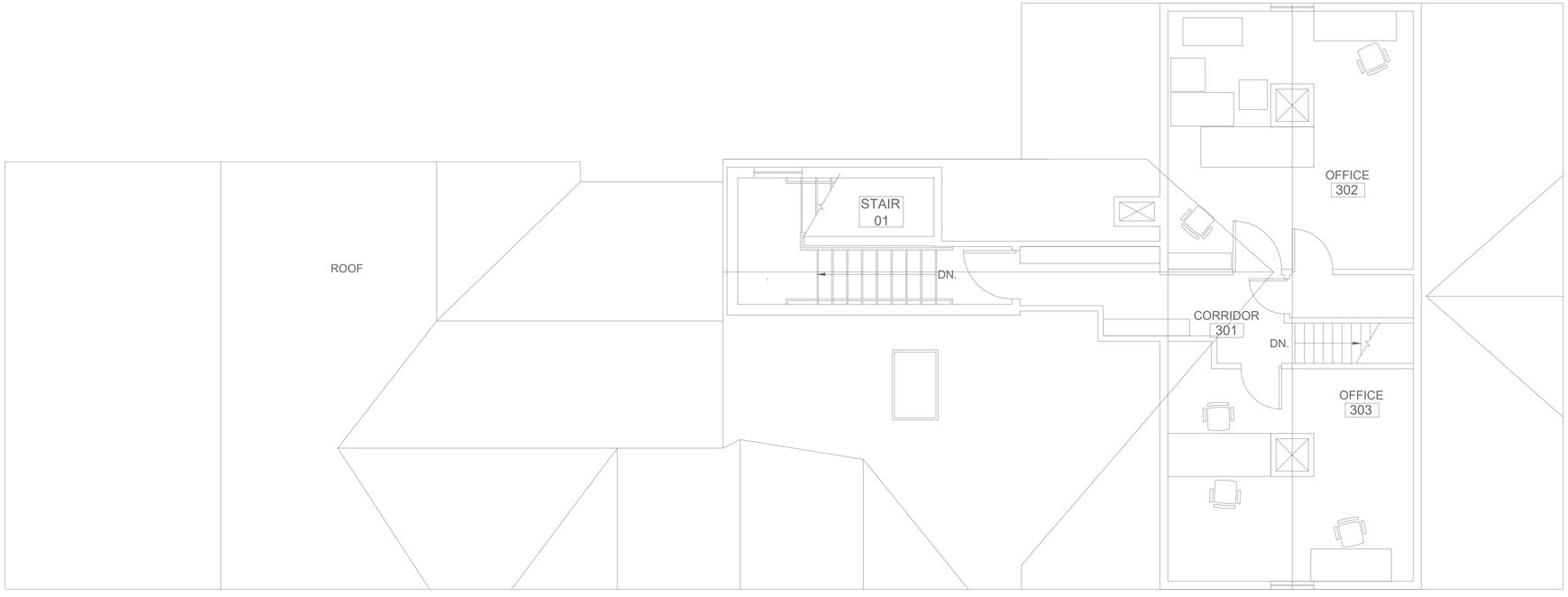
ASBESTOS LEGEND

DH-002A — SAMPLE NUMBER AND LOCATION TESTING NEGATIVE FOR ASBESTOS



SECOND FLOOR

SCALE: NOT TO SCALE



THIRD FLOOR

SCALE: NOT TO SCALE

REV.	DATE	DESCRIPTION	BY	CHK.

DRAWING ISSUE STATUS

NOT FOR CONSTRUCTION

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING
One Merchants Plaza, Suite 701
Bangor, Maine 04401
207.989.4824
WWW.HALEYWARD.COM

PROJECT

Daschlager House
(BGS3560)
55 Capital St. Augusta. Me 04330

TITLE

SECOND & THIRD FLOOR PLAN
HAZARDOUS MATERIAL ASSESSMENT

DATE	SCALE
2024.05.23	AS NOTED

DRAWN BY	DESIGNED BY	CHECKED BY
MEB	DAK	DAK

PROJECT No. 10377.040

DRAWING No. **H102** REV.

FILE LOCATION: P:\ME\10377-BUREAU_OF_GENERAL_SERVICES\040-3 HMAS DASCHLAGER HOUSE MCLEAN HOUSE NASH SCHOOL\ARDS\D-CAD_FILES\ENVIRONMENTAL\10377.040 DASCHLAGER HOUSE - H102.DWG, 2024.05.23, 9:03 AM

APPENDIX A

ASBESTOS AND LEAD-BASED PAINT RISK ASSESSOR CERTIFICATIONS

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JANET T. MILLS
GOVERNOR

MELANIE LOYZIM
COMMISSIONER

December 5, 2023

Haley Ward, Inc.
One Merchants Plaza Suite 701
Bangor, Maine 04401

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.

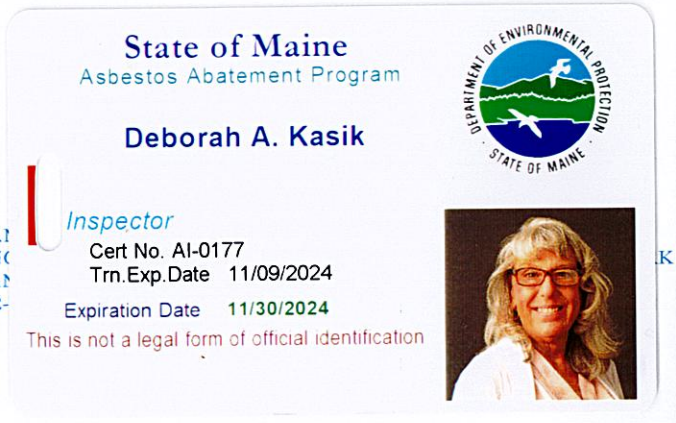
As a reminder, prior to renewing your asbestos certification, the State of Maine **requires** an annual refresher course to be taken before submitting a renewal application. A certificate shall expire one year from the last day of the month from the date of issuance, **or on the last day of the month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

Name	Category	Certification #	Exp. Date
Deborah A. Kasik	Inspector	AI-0177	11/30/2024
Dennis B. Kingman, Jr.	Inspector	AI-0034	11/30/2024

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) 287-7688 FAX: (207) 287-7826

BANGOR
106 HOGAN ROAD, SUITE 6
BANGOR, MAINE 04401
(207) 941-4570 FAX: (207) 941-4584

PORTLAND
312 CANCO
PORTLAND
(207) 822-

website: www.maine.gov/dep

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JANET T. MILLS
GOVERNOR

MELANIE LOYZIM
COMMISSIONER

January 21, 2024

Attn: Deborah A. Kasik
Haley Ward, Inc.
One Merchant's Plaza Suite 701
Bangor, Maine 04401

Dear Ms. Kasik,

Your lead application for certification has been received and **approved**. You have been granted certification as a **Lead Risk Assessor LR-0003**. Enclosed is your wallet card, with an expiration date of **January 4, 2025**. All employees working on a lead abatement project must carry this photo ID wallet card. The card is property of the individual to whom it is issued. Your responsibility as a licensee is to ensure delivery of the card to person 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.

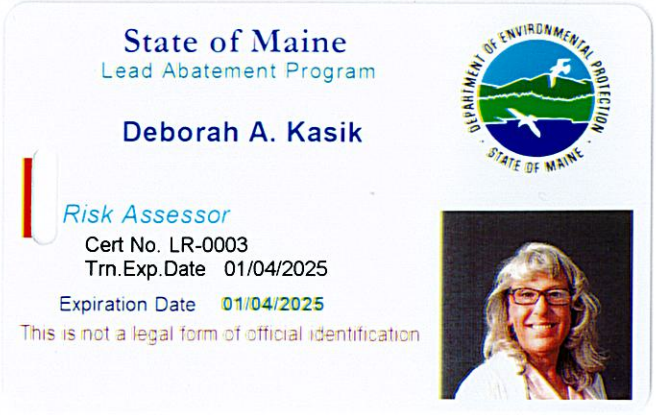
Thank you for your cooperation and your completed application(s). Applications can now be found on our DEP webpage at the following:
https://www.maine.gov/dep/waste/lead/forms/index.html

If you have any questions on this certification or on any other aspect of DEP's lead abatement licensing program, please call Sandy Moody (207) 242-0877 or email sandy.j.moody@maine.gov

Sincerely,

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

Enclosure



AUGUSTA
17 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0017
(207) 287-7688 FAX: (207) 287-7826
RAY BLDG., HOSPITAL ST.

BANGOR
106 HOGAN ROAD, SUITE 6
BANGOR, MAINE 04401
(207) 941-4570 FAX: (207) 941-4584

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

PRESQUE ISLE
1235 CENTRAL DRIVE, SKYWAY PARK
PRESQUE ISLE, MAINE 04679-2094
(207) 764-0477 FAX: (207) 760-3143

web site: www.maine.gov/dep

APPENDIX B

ASBESTOS ANALYTICAL LABORATORY CERTIFICATIONS

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JANET T. MILLS
GOVERNOR

MELANIE LOYZIM
COMMISSIONER

September 2, 2023

Attn: Lorie Dennis,| QA Certification Coordinator
EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077

Dear Ms. Dennis,

This is to confirm that the Maine Department of Environmental Protection is in receipt of your request to add the following labs to your licensing of Analytical Laboratories: Boston, MA., South Portland, Maine, Wallingford, CT and Carle Place, NY.

LA-0038 for Asbestos Analytical Laboratory (Air), expires on 10/31/2024
LB-0039 for Asbestos Analytical Laboratory (Bulk), expires on 10/31/2024

Remember each laboratory must have certified individual(s) within the lab to perform analyses.

If you need any further assistance please feel free to contact me at (207) 242-0877 or e-mail at sandy.j.moody@maine.gov.

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) 287-7688 FAX: (207) 287-7826
RAY BLDG., HOSPITAL ST.

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106 HOGAN ROAD, SUITE 6
BANGOR, MAINE 04401
(207) 941-4570 FAX: (207) 941-4584

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

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1235 CENTRAL DRIVE, SKYWAY PARK
PRESQUE ISLE, MAINE 04679-2094
(207) 764-0477 FAX: (207) 760-3143

web site: www.maine.gov/dep

State of Maine
Department of Environmental Protection

LICENSE

EMSL Analytical, Inc.

Asbestos Analytical Laboratory
(Air)

License Number: LA-0038

Expiration Date: 10/31/2024

State of Maine
Department of Environmental Protection

LICENSE

EMSL Analytical, Inc.

Asbestos Analytical Laboratory
(Bulk)

License Number: LB-0039

Expiration Date: 10/31/2024

S. PORTLAND - INDIVIDUAL ANALYST CERTIFICATIONS

State of Maine

October 30, 2023

Employee Name	*Lab Location*	*State Certified*	*Certification No.*	*Type of Cert.*	*Exp. Date*
Stephen Severn	S. Portland	Maine	AA-0497	Air Asbestos Analyst	10/31/2024
Stephen Severn	S. Portland	Maine	BA-0178	Bulk Asbestos Analyst	10/31/2024
Stefan Reis	S. Portland	Maine	BA-0233	Bulk Asbestos Analyst	5/31/2024

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 500094-0

EMSL Analytical, Inc.

South Portland, ME

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Asbestos Fiber Analysis

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2023-10-01 through 2024-09-30

Effective Dates

For the National Voluntary Laboratory Accreditation Program

National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

EMSL Analytical, Inc.
161 John Roberts Road
South Portland, ME 04106
Stephen Severn
Phone: 207-517-6921
Email: ssevern@emsl.com
http://www.emsl.com

ASBESTOS FIBER ANALYSIS **NVLAP LAB CODE 500094-0**

Bulk Asbestos Analysis

Code	***Description***
18/A01	EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

For the National Voluntary Laboratory Accreditation Program

AIHA Laboratory Accreditation Programs, LLC

acknowledges that

EMSL Analytical, Inc.

200 Route 130 North Cinnaminson, NJ 08077

Laboratory ID: LAP-100194

along with all premises from which key activities are performed, as listed above, has fulfilled the requirements of the AIHA Laboratory Accreditation Programs (AIHA LAP), LLC accreditation to the ISO/IEC 17025:2017 international standard, General Requirements for the Competence of Testing and Calibration Laboratories in the following:

LABORATORY ACCREDITATION PROGRAMS

☑	**INDUSTRIAL HYGIENE**	Accreditation Expires: January 01, 2025
☑	**ENVIRONMENTAL LEAD**	Accreditation Expires: January 01, 2025
☑	**ENVIRONMENTAL MICROBIOLOGY**	Accreditation Expires: January 01, 2025
☐	**FOOD**	Accreditation Expires:
☐	**UNIQUE SCOPES**	Accreditation Expires:

Specific Field(s) of Testing (FoT)/Method(s) within each Accreditation Program for which the above named laboratory maintains accreditation is outlined on the attached Scope of Accreditation. Continued accreditation is contingent upon successful on-going compliance with ISO/IEC 17025:2017 and AIHA LAP, LLC requirements. This certificate is not valid without the attached Scope of Accreditation. Please review the AIHA LAP, LLC website (www.aihaaccreditedlabs.org) for the most current Scope.

Cheryl O. Morton

Cheryl O Morton
Managing Director, AIHA Laboratory Accreditation Programs, LLC

Revision20: 06/07/2022

Date Issued: 01/01/2023

AIHA Laboratory Accreditation Programs, LLC

SCOPE OF ACCREDITATION

EMSL Analytical, Inc.
200 Route 130 North Cinnaminson, NJ 08077

Laboratory ID: LAP-100194
Issue Date: 01/01/2023

The laboratory is approved for those specific field(s) of testing/methods listed in the table below. Clients are urged to verify the laboratory's current accreditation status for the particular field(s) of testing/Methods, since these can change due to proficiency status, suspension and/or withdrawal of accreditation.

Industrial Hygiene Laboratory Accreditation Program (IHLAP)

Initial Accreditation Date: 02/01/1989

IHLAP Scope Category	Field of Testing (FOT)	Technology sub-type/Detector	Published Reference Method/Title of In-house Method	Component, parameter or characteristic tested
Asbestos/Fiber Microscopy Core	Phase Contrast Microscopy (PCM)	-	NIOSH 7400	Asbestos/Fibers
Asbestos/Fiber Microscopy Core	Polarized Light Microscopy (PLM)	-	EPA 600/R-93/116	Asbestos & Other Fibers in Bulk
Asbestos/Fiber Microscopy Core	Transmission Electron Microscopy (TEM)	-	EPA AHERA - 40 CFR Part 763	Asbestos
Asbestos/Fiber Microscopy Core	Transmission Electron Microscopy (TEM)	-	NIOSH 7402	Asbestos/Fibers
Chromatography Core	GC/MS	-	EPA TO-15	Volatile Organic Compounds
Chromatography Core	Gas Chromatography	GC/ECD	NIOSH 5502 Modified	Aldrin & Lindane
Chromatography Core	Gas Chromatography	GC/ECD	NIOSH 5503 Modified	Polychlorinated biphenyls
Chromatography Core	Gas Chromatography	GC/ECD	NIOSH 5510 Modified	Chlordane
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1003 Modified	Halogenated Hydrocarbons
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1005 Modified	Methylene Chloride
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1400 Modified	Alcohols
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1500 Modified	Hydrocarbons
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1501 Modified	Aromatic Hydrocarbons
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1550 Modified	Total Petroleum Hydrocarbons
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1603 Modified	Acetic Acid
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 2000 Modified	Methyl Alcohol
Chromatography Core	Gas Chromatography (Diffusive Samplers)	-	NIOSH 1501	Aromatic Hydrocarbons

APPENDIX C

ASBESTOS LABORATORY ANALYTICAL RESULTS

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

EMSL Order ID: 622400373
Customer ID: CESI62
Customer PO:
Project ID:

Attn: Deb Kasik
Haley Ward
1 Merchant's Plaza
7th Floor
Bangor, ME 04401

Phone: (207) 989-4824
Fax: (207) 989-4881
Collected: 5/ 7/2024
Received: 5/09/2024
Analyzed: 5/16/2024

Proj: 10377.040 DACHSLAGER HOUSE (BGS-3560)

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: DH-001A **Lab Sample ID:** **622400373-0001**
Sample Description: BASEMENT B01 STORAGE/SHEETROCK

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	5.0%	95.0%	None Detected	

Client Sample ID: DH-001B **Lab Sample ID:** **622400373-0002**
Sample Description: RM 117 CLOSET/SHEETROCK

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	5.0%	95.0%	None Detected	

Client Sample ID: DH-001C **Lab Sample ID:** **622400373-0003**
Sample Description: RM 209 BATH/SHEETROCK

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	5.0%	95.0%	None Detected	

Client Sample ID: DH-002A **Lab Sample ID:** **622400373-0004**
Sample Description: BASEMENT B01 STORAGE/REFRACTORY CEMENT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: DH-002B **Lab Sample ID:** **622400373-0005**
Sample Description: BASEMENT B01 STORAGE/REFRACTORY CEMENT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: DH-002C **Lab Sample ID:** **622400373-0006**
Sample Description: BASEMENT B01 STORAGE/REFRACTORY CEMENT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: DH-003A **Lab Sample ID:** **622400373-0007**
Sample Description: BASEMENT B01 STORAGE/WALLBOARD MATERIAL

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Brown	90.0%	10.0%	None Detected	

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EMSL Order ID: 622400373
Customer ID: CESI62
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: DH-004A ***Lab Sample ID:*** **622400373-0008**
Sample Description: BASEMENT B01 STORAGE/MASONRY SKIMCOAT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	White	0.0%	100.0%	None Detected	

Client Sample ID: DH-004B ***Lab Sample ID:*** **622400373-0009**
Sample Description: BASEMENT B01 STORAGE/MASONRY SKIMCOAT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	White	0.0%	100.0%	None Detected	

Client Sample ID: DH-004C ***Lab Sample ID:*** **622400373-0010**
Sample Description: BASEMENT B01 STORAGE/MASONRY SKIMCOAT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	White	0.0%	100.0%	None Detected	

Client Sample ID: DH-005A ***Lab Sample ID:*** **622400373-0011**
Sample Description: STAIR 01 (BASEMENT)/FT 12" MOTTLED - FLOOR TILE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Tan	0.0%	100%	None Detected	

Client Sample ID: DH-005B ***Lab Sample ID:*** **622400373-0012**
Sample Description: STAIR 01 (BASEMENT)/FT 12" MOTTLED - FLOOR TILE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Tan	0.0%	100%	None Detected	

Client Sample ID: DH-005C ***Lab Sample ID:*** **622400373-0013**
Sample Description: STAIR 01 (1ST)/FT 12" MOTTLED - FLOOR TILE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Tan	0.0%	100%	None Detected	

Client Sample ID: DH-006A ***Lab Sample ID:*** **622400373-0014**
Sample Description: STAIR 01 (BASEMENT)/FT TAN ADHESIVE - ADHESIVE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Tan	0.0%	100%	None Detected	

Client Sample ID: DH-006B ***Lab Sample ID:*** **622400373-0015**
Sample Description: STAIR 01 (BASEMENT)/FT TAN ADHESIVE - ADHESIVE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Tan	0.0%	100%	None Detected	

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EMSL Order ID: 622400373
Customer ID: CESI62
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: DH-006C ***Lab Sample ID:*** **622400373-0016**
Sample Description: STAIR 01 (1ST)/FT TAN ADHESIVE - ADHESIVE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Tan	0.0%	100%	None Detected	

Client Sample ID: DH-007A ***Lab Sample ID:*** **622400373-0017**
Sample Description: RM 117 CLOSET (WALL)/PLASTER-SKIMCOAT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	White	0.0%	100.0%	None Detected	

Client Sample ID: DH-007B ***Lab Sample ID:*** **622400373-0018**
Sample Description: RM 116 LIBRARY (CEILING)/PLASTER-SKIMCOAT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	White	0.0%	100.0%	None Detected	

Client Sample ID: DH-007C ***Lab Sample ID:*** **622400373-0019**
Sample Description: RM 206 CLOSET/PLASTER-SKIMCOAT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	White	0.0%	100.0%	None Detected	

Client Sample ID: DH-008A ***Lab Sample ID:*** **622400373-0020**
Sample Description: RM 117 CLOSET/PLASTER-BROWN COAT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: DH-008B ***Lab Sample ID:*** **622400373-0021**
Sample Description: RM 116 LIBRARY (CEILING)/PLASTER-BROWN COAT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: DH-008C ***Lab Sample ID:*** **622400373-0022**
Sample Description: RM 206 CLOSET/PLASTER-BROWN COAT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: DH-009A ***Lab Sample ID:*** **622400373-0023**
Sample Description: RM 117 NEAR EXIT DOOR/CARPET ADHESIVE - ADHESIVE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Tan	0.0%	100%	None Detected	

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Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: DH-009B ***Lab Sample ID:*** **622400373-0024**
Sample Description: RM 116/CARPET ADHESIVE - ADHESIVE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Tan	0.0%	100%	None Detected	

Client Sample ID: DH-009C ***Lab Sample ID:*** **622400373-0025**
Sample Description: RM 201 CORRIDOR/CARPET ADHESIVE - ADHESIVE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Tan	0.0%	100%	None Detected	

Client Sample ID: DH-010A ***Lab Sample ID:*** **622400373-0026**
Sample Description: RM 104/CT 4X2 FIS W/ PINHOLE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	95.0%	5.0%	None Detected	

Client Sample ID: DH-010B ***Lab Sample ID:*** **622400373-0027**
Sample Description: RM 104/CT 4X2 FIS W/ PINHOLE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	95.0%	5.0%	None Detected	

Client Sample ID: DH-010C ***Lab Sample ID:*** **622400373-0028**
Sample Description: RM 104/CT 4X2 FIS W/ PINHOLE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	95.0%	5.0%	None Detected	

Client Sample ID: DH-011A ***Lab Sample ID:*** **622400373-0029**
Sample Description: RM 201 STAIRS/TEXTURED CEILING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	White	0.0%	100.0%	None Detected	

Client Sample ID: DH-011B ***Lab Sample ID:*** **622400373-0030**
Sample Description: RM 201 STAIRS/TEXTURED CEILING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	White	0.0%	100.0%	None Detected	

Client Sample ID: DH-011C ***Lab Sample ID:*** **622400373-0031**
Sample Description: RM 201 STAIRS/TEXTURED CEILING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	White	0.0%	100.0%	None Detected	

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Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: DH-012A ***Lab Sample ID:*** **622400373-0032**

Sample Description: RM 204/FT-12" DARK GRAY MOTTLED W/ ADHESIVE - FLOOR TILE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Gray	0.0%	100%	None Detected	

Client Sample ID: DH-012B ***Lab Sample ID:*** **622400373-0033**

Sample Description: RM 204/FT-12" DARK GRAY MOTTLED W/ ADHESIVE - FLOOR TILE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Gray	0.0%	100%	None Detected	

Client Sample ID: DH-012C ***Lab Sample ID:*** **622400373-0034**

Sample Description: RM 209/FT-12" DARK GRAY MOTTLED W/ ADHESIVE - FLOOR TILE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Gray	0.0%	100%	None Detected	

Client Sample ID: DH-013A ***Lab Sample ID:*** **622400373-0035**

Sample Description: EXT (FROM RM 203)/WINDOW GLAZING - GLAZING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	White	0.0%	100%	None Detected	

Client Sample ID: DH-013B ***Lab Sample ID:*** **622400373-0036**

Sample Description: EXTERIOR/WINDOW GLAZING - GLAZING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	White	0.0%	100%	None Detected	

Client Sample ID: DH-013C ***Lab Sample ID:*** **622400373-0037**

Sample Description: EXTERIOR/WINDOW GLAZING - GLAZING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	White	0.0%	100%	None Detected	

Client Sample ID: DH-014A ***Lab Sample ID:*** **622400373-0038**

Sample Description: EXTERIOR/WHITE CAULK - CAULK

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	White	0.0%	100%	None Detected	

Client Sample ID: DH-014B ***Lab Sample ID:*** **622400373-0039**

Sample Description: EXTERIOR/WHITE CAULK - CAULK

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	White	0.0%	100%	None Detected	

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EMSL Order ID: 622400373
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Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: DH-014C ***Lab Sample ID:*** **622400373-0040**

Sample Description: EXTERIOR/WHITE CAULK - CAULK

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	White	0.0%	100%	None Detected	

Client Sample ID: DH-015A ***Lab Sample ID:*** **622400373-0041**

Sample Description: EXTERIOR (CONF. RM SIDES ONLY)/SKIMCOAT ON FOUNDATION

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: DH-015B ***Lab Sample ID:*** **622400373-0042**

Sample Description: EXTERIOR (CONF. RM SIDES ONLY)/SKIMCOAT ON FOUNDATION

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: DH-015C ***Lab Sample ID:*** **622400373-0043**

Sample Description: EXTERIOR (CONF. RM SIDES ONLY)/SKIMCOAT ON FOUNDATION

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	5/14/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: DH-016A ***Lab Sample ID:*** **622400373-0044**

Sample Description: EXTERIOR (BENEATH SIDING)/ASPHALT FELT MATERIAL (BENEATH SIDING) - ASPHALT FELT MATERIAL

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Black	0.0%	100%	None Detected	

Client Sample ID: DH-016B ***Lab Sample ID:*** **622400373-0045**

Sample Description: EXTERIOR (BENEATH SIDING)/ASPHALT FELT MATERIAL (BENEATH SIDING) - ASPHALT FELT MATERIAL

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Black	0.0%	100%	None Detected	

Client Sample ID: DH-016C ***Lab Sample ID:*** **622400373-0046**

Sample Description: EXTERIOR (BENEATH SIDING)/ASPHALT FELT MATERIAL (BENEATH SIDING) - ASPHALT FELT MATERIAL

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	5/16/2024	Black	0.0%	100%	None Detected	

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EMSL Order ID:	622400373
Customer ID:	CESI62
Customer PO:	
Project ID:	

Summary Test Report for Asbestos Analysis of Bulk Material

PLM: ME CERT # BA-0178

PLM EPA NOB: ME CERT # BA-0178

Analyst(s):

Stephen Severn PLM (25)
PLM Grav. Reduction (21)

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: 05/16/202416:36:13

OrderID: 622400373

Asbestos Bulk Building Materials - Chain of Custody

EMSL ANALYTICAL, INC.
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South Portland, ME 04106
PHONE: (207) 517-6921
EMAIL: portlandlab@emsl.com

EMSL Order Number / Lab Use Only

#622400373

Customer Information		Billing Information	
Customer ID:	CESI62	Billing ID:	
Company Name:	Haley Ward	Company Name:	Haley Ward
Contact Name:	Deb Kasik	Billing Contact:	Deb Kasik
Street Address:	1 Merchant's Plaza 7th Floor, Suite 701	Street Address:	1 Merchant's Plaza, 7th Floor
City, State, Zip:	Bangor ME 04401 Country: US	City, State, Zip:	Bangor ME Country: US
Phone:	207-989-4824	Phone:	207-989-4824
Email(s) for Report:	dkasik@haleyward.com	Email(s) for Invoice:	joreskovich@haleyward.com

Project Information

Project Name/No:	10377.040 Dachslager House (BGS-3560)	Purchase Order:	
EMSL LIMS Project ID: (If applicable, EMSL will provide)		US State where samples collected: ME	State of Connecticut (CT) must select project location: ☐ Commercial (Taxable) ☐ Residential (Non-Taxable)
Sampled By Name:	Deb Kasik	Sampled By Signature:	Deborah A Kasik
Date Sampled:	5/7/24	No. of Samples in Shipment	45

Turn-Around-Time (TAT)

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 32 Hour ☐ 48 Hour ☐ 72 Hour ☑ 96 Hour ☐ 1 Week ☐ 2 Week

Please call ahead for large projects and/or turnaround times 6 Hours or Less. *32 Hour TAT available for select tests only; samples must be submitted by 11:30am.

Test Selection

PLM - Bulk (reporting limit)

- ☑ PLM EPA 600/R-93/116 (<1%)
- ☑ PLM EPA NOB (<1%)
- ☐ POINT COUNT
  - ☐ 400 (<0.25%) ☐ 1,000 (<0.1%)
- ☐ POINT COUNT w/ GRAVIMETRIC
  - ☐ 400 (<0.25%) ☐ 1,000 (<0.1%)
- ☐ NIOSH 9002 (<1%)
- ☐ NYS 198.1 (Friable - NY)
- ☐ NYS 198.6 NOB (Non-Friable - NY)
- ☐ NYS 198.8 (Vermiculite SM-V)

TEM - Bulk

- ☐ TEM EPA NOB
- ☐ NYS NOB 198.4 (Non-Friable - NY)
- ☐ TEM EPA 600/R-93/116 w Milling Prep (0.1%)

Other Tests (please specify)

☑ Positive Stop - Clearly Identified Homogeneous Areas (HA)

Sample Number	HA Number	Sample Location	Material Description
DH-001A		Basement B01 Storage	Sheetrock
B		Rm 117 Closet	↓
C		Rm 209 Bath	↓
DH-002A		Basement B01 Storage	Refractory Cement
B		↓	↓
C		↓	↓
003A		Basement B01 Storage	Wallboard Material
004A		Basement B01 Storage	Masonry Skimcoat
B		↓	↓
C		↓	↓

RECEIVED
MAY 09 2024
BY: AR

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

NOB per MDEP

Method of Shipment:	Fed Ex	Sample Condition Upon Receipt:	
Relinquished by:	Deborah A. Kasik DAK	Date/Time: 5/7/24 4:45 pm	Received by: AR Date/Time: 5/9/24 1100
Relinquished by:		Date/Time:	Received by: Date/Time

Controlled Document - Asbestos Bulk R7 9/14/2021

☐ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s 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 by Customer.

FedEx # 7968 4857 4325

OrderID: 622400373

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Asbestos Bulk Building Materials - Chain of Custody

EMSL Order Number / Lab Use Only

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

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

NoB per MDEP

Sample Number	HA Number	Sample Location	Material Description
DH-005A		Stair 01 (Bsmnt)	FT 12" tan mottled
B		Stair 01 (Bsmnt)	↓
C		Stair 01 (1st)	↓
006A		Stair 01 (Bsmnt)	FT Tan Adhesive
B		Stair 01 (Bsmnt)	↓
C		Stair 01 (1st)	↓
007A		Rm 117 Closet (wall)	Plaster - Skimcoat
B		Rm 116 Library (ceiling)	↓
C		Rm 206 Closet	↓
008A		Rm 117 Closet	Plaster - Brown coat
B		Rm 116 Library (ceiling)	↓
C		Rm 206 Closet	↓
009A		Rm 117 near exit door	Carpet Adhesive
B		Rm 116	↓
C		Rm 201 Corridor	↓
010A		Rm 104	CT 4x2 fis w/pinhole
B		Rm 104	↓
C		Rm 104	↓
011A		Rm 201 Stairs	Textured ceiling
B		Rm 201 Stairs	↓
C		Rm 201 Stairs	↓
012A		Rm 204	FT- 12" dark gray mottled w/adhesive
B		Rm 204	↓
C		Rm 209	↓
013A		Ext (From Rm 203)	Window glazing

Method of Shipment: Fed Ex		Sample Condition Upon Receipt:	
Relinquished by: Deborah Klasik	Date/Time: 5/7/24 4:45 pm	Received by: AR	Date/Time: 5/8/24 1100
Relinquished by:	Date/Time:	Received by:	Date/Time

Controlled Document - Asbestos Bulk R7 09/14/2021

☐ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s 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 by Customer.

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Asbestos Bulk Building Materials - Chain of Custody

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Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

NOB per MDEP

Sample Number	HA Number	Sample Location	Material Description
PH-013B		Exterior	Window glazing
C		Exterior	Window glazing
014A		Exterior	White caulk
B		↓	↓
C		↓	↓
015A		Exterior (Conf. Rm sides only)	Skimcoat on foundation
B		↓	↓
C		↓	↓
016A		Exterior (beneath siding)	Asphalt felt material (beneath siding)
B		↓	↓
C		↓	↓

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EMSL Analytical, Inc.'s 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 by Customer.

APPENDIX D

LEAD-BASED PAINT DETERMINATION

ENVIRONMENTAL LEAD-BASED PAINT XRF RESULTS

HALEY WARD	**CLIENT:**	BUREAU OF GENERAL SERVICES	**DATE:**	5/7/2024
	SITE:	DASCHLAGER HOUSE, 55 CAPITOL STREET, AUGUSTA	**HALEY WARD #:**	10377.040
	BLDG:	**INTERIOR**	**Page:**	1

XRF # **RMD LPA-1 #3305; ME Radiation License #31223** **Inspector Signature:** *Deborah A. Kasik/LR#0003*

FIELD ID #	SAMPLE LOCATION	SIDE	COMPONENT(S)	COLOR	SUBSTRATE TYPE:	RESULTS mg/cm²	CONDITION	NOTES:
L-1	PRE-CALIBRATION		NIST	YELLOW	WOOD	1.0		
L-2	PRE-CALIBRATION		NIST	YELLOW	WOOD	1.1		
L-3	PRE-CALIBRATION		NIST	YELLOW	WOOD	1.0		
L-4	BASEMENT RM B07		FLOOR	GRAY	CONCRETE	0.0		
L-5			STAIR TREADS AND RISERS	GRAY	WOOD	0.0/0.0		TO EXTERIOR
L-6			WALLS	WHITE	DRYWALL	0.0		
L-7	BASEMENT RM B06		CEILING	WHITE	DRYWALL	0.0		
L-8			WALLS	OFF WHITE	DRYWALL	0.0		
L-9			BASEBOARDS	OFF WHITE	WOOD	0.0		
L-10			FLOOR	GRAY / WHITE	CONCRETE	0.0		
L-11	BASEMENT HALLWAY		PIPING	WHITE	METAL	0.0		
L-12			DOOR, CASING, JAMB	WHITE	WOOD	0.0		
L-13			BASEBOARDS	WHITE	WOOD	0.0		
L-14			DOOR TO B04	WHITE	WOOD	0.0		
L-15	BASEMENT RM B01		CEILING	WHITE WASH	WOOD	0.0		
L-16			**WALLS**	**GRAY**	**BRICK**	**1.2**	**FAIR**	
L-17			BASEMENT WINDOW SASH	STAIN	WOOD	0.0		
L-18			SUPPORT POST	MAROON	METAL	0.0		

= Drywall; P = Plaster; W = Wood; M = Metal; C = Concrete; B = Brick; V = Vinyl; CER = Ceramic; O = Other (indicate material). Results expressed as mg/cm² (milligrams per square centimet

ENVIRONMENTAL LEAD-BASED PAINT XRF RESULTS

HALEY WARD	**CLIENT:**	BUREAU OF GENERAL SERVICES	**DATE:**	5/7/2024
	SITE:	DASCHLAGER HOUSE, 55 CAPITOL STREET, AUGUSTA	**HALEY WARD #:**	10377.040
	BLDG:	**INTERIOR**	**Page:**	2

XRF # **RMD LPA-1 #3305; ME Radiation License #31223** ***Inspector Signature:*** *Deborah A. Kasik/LR#0003*

FIELD ID #	SAMPLE LOCATION	SIDE	COMPONENT(S)	COLOR	SUBSTRATE TYPE:	RESULTS mg/cm²	CONDITION	NOTES:
L-19	BASEMENT RM B01 CONT'D		VERTICAL SUPPORT COLUMN	MIX	WOOD	0.5		
L-20			**STAIR TREADS**	**GRAY**	**WOOD**	**3.1**	**POOR**	
L-21			**STAIR RISERS**	**GRAY**	**WOOD**	**6.6**	**POOR**	
L-22			**STAIR HANDRAIL**	**GRAY**	**WOOD**	**3.5**	**POOR**	
L-23			**STAIR WALLS - UPPER**	**MIX**	**PLASTER**	**3.3**	**FAIR-POOR**	
L-24			**STAIR WALLS - LOWER**	**MIX**	**WOOD**	**5.0**	**FAIR-POOR**	
L-25			**CEILING**	**MIX**	**PLASTER**	**1.4**	**FAIR-POOR**	
L-26			WALL	WHITE	BRICK	0.0		
L-27	GROUND (1ST) FLOOR; 101		CEILING	WHITE	PLASTER / WOOD	0.2/0.4		TEXTURED; INCLUDES TRIM
L-28			**WALLS**	**OFF WHITE**	**PLASTER**	**POSITIVE**		
L-29			**DOOR TRIM**	**WHITE**	**WOOD**	**>9.9**	**GOOD-FAIR**	**INCLUDES DEC. SCROLLS AND PANELS**
L-30			STAIRS TREAD	STAIN	WOOD	0.0		
L-31			**STAIR RISERS**	**WHITE**	**WOOD**	**>9.9**	**GOOD**	
L-32			**STAIR BALUSTERS**	**WHITE**	**WOOD**	**>9.9**	**GOOD**	
L-33			**STAIR MOPBOARD**	**WHITE**	**WOOD**	**>9.9**	**GOOD**	
L-34			**STAIR NEWELL POSTS**	**WHITE**	**WOOD**	**>9.9**	**GOOD**	
L-35	GROUND (1ST) FLOOR; 102		WALLS	OFF WHITE	PLASTER	0.5		
L-36			WINDOW TRIM	WHITE	WOOD	>9.9	GOOD	
L-37			ARCHWAY	OFF WHITE	PLASTER	0.8		
L-38	**GROUND (1ST) FLOOR; 104**		**CEILING ABOVE CT**	**OFF WHITE**	**TIN**	**>9.9/>9.9**	**GOOD-FAIR**	

D = Drywall; P = Plaster; W = Wood; M = Metal; C = Concrete; B = Brick; V = Vinyl; CER = Ceramic; O = Other (indicate material). Results expressed as mg/cm² (milligrams per square centimeter)

ENVIRONMENTAL LEAD-BASED PAINT XRF RESULTS

HALEY WARD	***CLIENT:***	BUREAU OF GENERAL SERVICES	***DATE:***	1/25/2023
	SITE:	DASCHLAGER HOUSE, 55 CAPITOL STREET, AUGUSTA	***HALEY WARD #:***	13577.001
	BLDG:	**INTERIOR**	***Page:***	3

XRF # **RMD LPA-1 #3305; ME Radiation License #31223** ***Inspector Signature:*** *Deborah A. Kasik/LR#0003*

FIELD ID #	***SAMPLE LOCATION***	***SIDE***	***COMPONENT(S)***	***COLOR***	***SUBSTRATE TYPE:***	***RESULTS mg/cm²***	***CONDITION***	***NOTES:***
L-39	**GROUND (1ST) FLOOR; 117**		**FIREPLACE TRIM**	**WHITE**	**WOOD**	**>9.9**	**GOOD**	
L-40			**FIREPLACE FLOOR AND FACE**	**MULTI**	**CERAMIC TILE**	**>9.9**	**GOOD**	
L-41			**CLOSET DOOR AND TRIM**	**WHITE**	**WOOD**	**>9.9**	**GOOD**	**INCLUDES DEC. TRIM**
L-42			**CLOSET FLOOR**	**STAIN**	**WOOD**	**0.0**		
L-43	**GROUND (1ST) FLOOR; 116**		**FIREPLACE TRIM**	**WHITE**	**WOOD**	**>9.9**	**GOOD**	
L-44			**WINDOW SASH**	**WHITE**	**WOOD**	**>9.9**	**GOOD**	
L-45			**WINDOW TRIM**	**WHITE**	**WOOD**	**>9.9**	**GOOD**	
L-46	GROUND (1ST) FLOOR; 115		DOOR AND DOOR TRIM	WHITE	WOOD	0.0/0.0		
L-47	**GROUND (1ST) FLOOR; 111**		**WALLS**	**OFF WHITE**	**PLASTER**	**>9.9**	**GOOD**	
L-48			WALLS	OFF WHITE	DRYWALL	0.0/0.0		
L-49			DOOR AND DOOR TRIM	WHITE	METAL / WOOD	0.0/0.0		TO EXTERIOR
L-50	SECOND FLOOR; 212		WINDOW SASH	WHITE	WOOD	0.0		
L-51			WINDOW TRIM	WHITE	WOOD	0.0		
L-52			DOOR AND DOOR TRIM	WHITE	WOOD	0.0		
L-53	**SECOND FLOOR; 211**		**FLOOR BENEATH CARPET**	**GRAY**	**WOOD**	**2.2**	**FAIR**	
L-54	**SECOND FLOOR; 206**		**CLOSET FLOOR**	**GRAY**	**WOOD**	**>9.9**	**FAIR**	
L-55			CLOSET WALLS	OFF WHITE	PLASTER	0.0/0.0		
L-56			PIPING	WHITE	METAL / WOOD	0.0		
L-57			**WINDOW SASH**	**WHITE**	**WOOD**	**>9.9**	**FAIR-POOR**	
L-58	SECOND FLOOR; 209		WALLS	OFF WHITE	DRYWALL	0.0		

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ENVIRONMENTAL LEAD-BASED PAINT XRF RESULTS

HALEY WARD	***CLIENT:***	BUREAU OF GENERAL SERVICES	***DATE:***	5/7/2024
	SITE:	DASCHLAGER HOUSE, 55 CAPITOL STREET, AUGUSTA	***HALEY WARD #:***	10377.040
	BLDG:	**INTERIOR / EXTERIOR**	***Page:***	4

XRF # **RMD LPA-1 #3305; ME Radiation License #31223** ***Inspector Signature:*** *Deborah A. Kasik/LR#0003*

FIELD ID #	***SAMPLE LOCATION***	***SIDE***	***COMPONENT(S)***	***COLOR***	***SUBSTRATE TYPE:***	***RESULTS mg/cm²***	***CONDITION***	***NOTES:***
L-59	SECOND FLOOR; 209 CONT'D		CERAMIC TILE	MULTI	CERAMIC TILE	0.0		
L-60	**SECOND FLOOR; 201**		**STAIR TREADS AND RISERS**	**WHITE**	**WOOD**	**>9.9**	**FAIR**	
L-61			**STAIR MOPBOARD**	**WHITE**	**WOOD**	**>9.9**	**FAIR**	
L-62			**STAIR SIDEBOARD**	**WHITE**	**WOOD**	**>9.9**	**GOOD-FAIR**	
L-63	**THIRD FLOOR; 301**		**HALL DOOR AND TRIM**	**WHITE**	**WOOD**	**>9.9**	**FAIR**	
L-64	**THIRD FLOOR; 303**		**CHIMNEY PLASTER**	**MULTI**	**PLASTER**	**>9.9**	**FAIR-POOR**	
L-65	EXTERIOR		SIDING	RED	BRICK	0.0/0.2		
L-66			**SIDING**	**RED**	**WOOD**	**>9.9**	**FAIR**	**OR REDDISH-PURPLE**
L-67			**UPPER TRIM**	**WHITE**	**WOOD**	**ASSUMED POSITIVE**	**FAIR-POOR**	**BASED ON FIRST LEVEL XRF READINGS**
L-68			**DOOR AND ASSOCIATED TRIM**	**WHITE**	**WOOD**	**>9.9**	**POOR**	
L-69			**WINDOW SASHES**	**WHITE**	**WOOD**	**>9.9**	**POOR**	
L-70			**WINDOW TRIM**	**WHITE**	**WOOD**	**>9.9**	**POOR**	
L-71			**WINDOW TRIM - DECORATIVE**	**WHITE**	**WOOD**	**>9.9**	**FAIR-POOR**	**ABOVE AND BENEATH UNITS**
L-72			**WINDOW SHUTTERS**	**WHITE**	**WOOD**	**2.9**	**POOR**	
L-73	POST CALIBRATION		NIST	YELLOW	WOOD	1.1		
L-74	POST CALIBRATION		NIST	YELLOW	WOOD	1.1		
L-75	POST CALIBRATION		NIST	YELLOW	WOOD	1.1		

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APPENDIX E

PHOTOGRAPHIC LOG

DASCHLAGER HOUSE (BGS 3560)
55 CAPITOL STREET, AUGUSTA, MAINE

Photo No. 1 **Photo Date:** May 7, 2024 **Site Location:** Daschlager House 55 Capitol Street Augusta, Maine **Description:** Basement – General Storage; LBP Stair Treads and Risers in poor condition. **Photo By:** DAK	

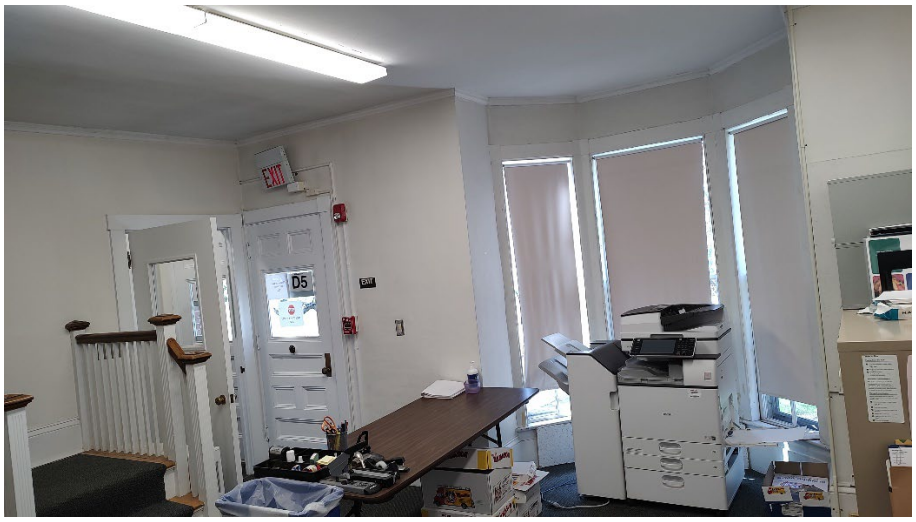
Photo No. 2 **Photo Date:** May 7, 2024 **Site Location:** Daschlager House 55 Capitol Street Augusta, Maine **Description:** LBP on windows, door trim, and stair components in File/Mail Room. Condition of paint ranged from good to fair. **Photo By:** DAK	

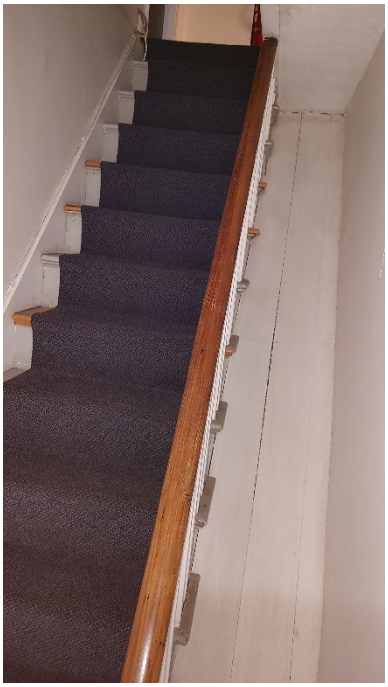
Photo No. 3 **Photo Date:** May 7, 2024 **Site Location:** Daschlager House 55 Capitol Street Augusta, Maine **Description:** LBP on painted stair components to the 3rd floor. Condition of paint ranges from good to fair. **Photo By:** DAK	

Photo No. 4 **Photo Date:** May 7, 2024 **Site Location:** Daschlager House 55 Capitol Street Augusta, Maine **Description:** LBP surface coating on tin ceiling located above ceiling tiles. Condition of paint is fair in damaged areas, good overall. **Photo By:** DAK	

Photo No. 5 **Photo Date:** May 7, 2024 **Site Location:** Daschlager House 55 Capitol Street Augusta, Maine **Description:** LBP surface coatings on exterior windows, doors and all associated and decorative trim. Condition of paint is primarily poor. **Photo By:** DAK	

Photo No. 6 **Photo Date:** May 7, 2024 **Site Location:** Daschlager House 55 Capitol Street Augusta, Maine **Description:** LBP surface coatings on clapboards, windows, window trim, window shutters and upper trim on side entry elevation. Condition of paint is fair to poor. **Photo By:** DAK	

DOCUMENT 00 31 32 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for 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 but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. A geotechnical investigation report, prepared by S.W. Cole Engineering, Inc., is available for viewing as appended to this Document
   1. The report for the Daschlager House, dated December 27, 2023

C. Related Requirements:

   1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.
   2. Document 003119 "Existing Condition Information" for information about existing conditions that is made available to bidders.
   3. Document 003126 "Existing Hazardous Material Information" for hazardous materials reports that are made available to bidders.

END OF DOCUMENT 00 31 32

S.W.COLE ENGINEERING, INC.

REPORT

23-1854

December 27, 2023

Explorations and Geotechnical Engineering Services

Proposed Building Addition
Daschlager House
55 Capital Street
Augusta, Maine

Prepared For:
Artifex Architects-Engineers
Attention: Rayshelly Lizotte, P.E.
175 Exchange Street
Bangor, Maine 04401

Prepared By:
S. W. Cole Engineering, Inc.
26 Coles Crossing Drive
Sidney, ME 04330-6700
T: 207.626.0600

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Appendix C Exploration Logs & Key

23-1854

December 27, 2023

Artifex Architects-Engineers
Attention: Rayshelly Lizotte, P.E.
175 Exchange Street
Bangor, ME 04401

Subject: Explorations and Geotechnical Engineering Services
Proposed Building Addition
Daschlager Housing
55 Capital Street
Augusta, Maine

Dear Shelly:

In accordance with our Proposal, dated October 3, 2023, we have performed subsurface explorations for the subject project. This report summarizes our findings and geotechnical recommendations, and its contents are subject to the limitations set forth in Appendix A.

1.0 INTRODUCTION

1.1 Scope and Purpose

The purpose of our services was to obtain subsurface information at the site in order to develop geotechnical recommendations relative to foundations and earthwork associated with the proposed construction. Our scope of services included four test borings, soils laboratory testing, a geotechnical analysis of the subsurface findings, and preparation of this report.

1.2 Site and Proposed Construction

The site is 55 Capital Street in Augusta. The site is bound to the north by Child Street, south by Capital Street, west by the McLean House, and east by the Maine Department of Transportation headquarters. Existing grades generally slope downward from west to east from about elevation 114 to 107 feet across the site.

We understand development plans call for construction of a new elevator addition with associated utility upgrades. We anticipate the proposed addition will be located within a relatively flat area at about elevation 110 to 111 feet on the easterly side of the existing building. We anticipate the proposed addition will be two stories with basement access. We anticipate the building addition will be a combination of steel and wood framing. We anticipate the addition will be supported on spread footing foundations. We anticipate the new addition will have a finish first-floor elevation at 114.1 feet.

Existing site features are shown on the “Exploration Location Plan” attached in Appendix B.

2.0 EXPLORATION AND TESTING

2.1 Explorations

Four test borings (B-201 and B-204) were made at the site on October 30 and 31, 2023, by S. W. Cole Explorations, LLC. The exploration locations were selected by Artifex Architects-Engineers and established in the field, where access allowed, by S. W. Cole Engineering, Inc. (S.W.COLE) using measurements from existing site features. The approximate exploration locations are shown on the “Exploration Location Plan” attached in Appendix B. Logs of the explorations and a key to the notes and symbols used on the logs are attached in Appendix C. The elevations shown on the logs were estimated based on topographic information shown on the “Exploration Location Plan”.

2.2 Field Testing

The test borings were drilled using a combination of hollow-stem augers, and cased wash-boring techniques. The soils were sampled at 2-to-5-foot intervals using a split-spoon sampler and Standard Penetration Testing (SPT) methods. Pocket Penetrometer Tests (PPT) were performed where stiffer cohesive soils were encountered. SPT blow counts and PPT results are shown on the logs.

2.3 Laboratory Testing

Soil samples obtained from the test borings were returned to our laboratory for further classification and testing. Moisture content test results are noted on the logs.

3.0 SUBSURFACE CONDITIONS

3.1 Soil and Bedrock

Test borings B-201 through B-204 were made in the area of the proposed development and encountered a soils profile generally consisting of surficial layer of pavement or topsoil overlying granular fill, overlying native sandy clayey silt transitioning to silty clay with fine sand with depth. The following is a summary of the principal soils strata encountered.

Not all the strata were encountered at each exploration; refer to the attached logs for more detailed subsurface information.

Fill: Below the surficial layer of pavement or topsoil, the explorations encountered granular fill to depths of about 3 to 6 feet. The fill generally consisted of loose, brown silty sand with trace to no gravel. Debris consisting of ash, wood, and rootlets were observed in the fill at borings B-201, B-203, and B-204.

Clayey Silt: Below the fill, native sandy clayey silt was encountered in each boring extending to depths of about 15 to 17 feet. The sandy clayey silt was typically very stiff to medium stiff.

Silty Clay: Below the sandy clayey silt, a deposit of medium stiff to soft, gray, silty clay was encountered in each boring. Each boring was terminated in the silty clay at a depth of 32 feet.

3.2 Groundwater

The soils in the explorations were generally moist from the ground surface. Water was measured in the test borings at depths of about 10 to 15 feet following drilling. It should be noted that water was introduced during drilling at depths of about 10 feet in each boring. Long term groundwater information is not available. It should be anticipated that groundwater levels will fluctuate, particularly in response to periods of snowmelt and precipitation, as well as changes in site use.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

Based on the subsurface findings, the proposed construction appears feasible from a geotechnical standpoint. The principle geotechnical considerations include:

- The proposed building addition is underlain by uncontrolled fills with ash, wood, brick, and organics (rootlets) to depths of about 5 to 6 feet. The uncontrolled fills should be completely removed from beneath the proposed addition. The extent of removal should extend 1 foot laterally outward from outside edge of perimeter footings for every 1-foot of excavation depth (1H:1V bearing splay). The over-excavated area should be backfilled with compacted Structural Fill.

- Spread footing foundations and on-grade floor slabs bearing on properly prepared subgrades appear suitable for the proposed building addition. Footings should bear on at least 6 inches of compacted Crushed Stone overlying properly prepared subgrades. On-grade floor slabs should bear on at least 12 inches of compacted Structural Fill overlying properly prepared subgrades.

- Perimeter underdrains bedded in Crushed Stone are recommended for the proposed addition.

- Subgrades across the site will consist of moisture-sensitive silty sands. Earthwork and grading activities should occur during drier, non-freezing weather of Spring, Summer, and Fall. Excavation of bearing surfaces should be completed with a smooth-edged bucket to lessen subgrade disturbance.

4.2 Site and Subgrade Preparation

We recommend site preparation begin with the construction of an erosion control system to protect adjacent drainage ways and areas outside the construction limits. Surficial pavement, organics, roots, and topsoil should be completely removed from areas of proposed fill and construction. As much pavement and vegetation as possible should remain outside the construction areas to lessen the potential for erosion and site disturbance.

We recommend footings be excavated using a smooth-edged bucket and that footings be underlain by at least 6 inches of compacted Crushed Stone overlying properly prepared subgrades.

4.3 Excavation and Dewatering

Excavations will generally encounter uncontrolled fills and sandy clayey silt. Care must be exercised during construction to limit disturbance of the bearing soils. Earthwork and grading activities should occur during drier, non-freezing weather of Spring, Summer, and Fall. Construction equipment should not operate directly on the native subgrade soils, when wet. Final cuts to subgrade should be performed with a smooth-edged bucket to help reduce strength loss from soil disturbance.

Sumping and pumping dewatering techniques should be adequate to control groundwater in excavations. Controlling the water levels to at least one foot below planned excavation depths will help stabilize subgrades during construction. Excavations must be properly shored or sloped in accordance with OSHA Regulations to prevent sloughing and caving of the sidewalls during construction. Care must be taken to preclude undermining the adjacent structure, utilities, and roadways. The design and planning of excavations, excavation support systems, and dewatering is the responsibility of the contractor.

4.4 Foundations

We recommend the proposed building addition be supported on spread footings founded on at least 6 inches of Crushed Stone bearing on compacted Structural Fill following over-excavation or undisturbed native soils. For foundations bearing on properly prepared subgrades, we recommend the following geotechnical parameters for design consideration:

Geotechnical Parameters for Spread Footings and Foundation Walls	
Design Frost Depth (100 year AFI)	4.5 feet
Net Allowable Soil Bearing Pressure	2.0 ksf
Base Friction Factor	0.35
Total Unit Weight of Backfill	125 pcf
At-Rest Lateral Earth Pressure Coefficient	0.5
Internal Friction Angle of Backfill	30°
Seismic Soil Site Class	E (IBC 2015)
Estimated Total Settlement	1-inch
Differential Settlement	½-inch

4.5 Foundation Drainage

We recommend an underdrain system be installed on the outside edge of perimeter footings. The underdrain pipe should consist of 4-inch diameter, perforated SDR-35 foundation drainpipe bedded in Crushed Stone and wrapped in non-woven geotextile fabric, such as Mirafi 160N. The underdrain pipe must have a positive gravity outlet protected from freezing, clogging and backflow. Surface grades should be sloped away from the building for positive surface water drainage. General underdrain details are illustrated on the "Foundation Detail Sketch" attached in Appendix B.

4.6 Slab-On-Grade

On-grade floor slabs in heated areas may be designed using a subgrade reaction modulus of 100 pci (pounds per cubic inch) provided the slab is underlain by at least 12 inches of compacted Structural Fill underlain by properly prepared subgrades. The structural engineer or concrete consultant must design steel reinforcing and joint spacing appropriate to slab thickness and function.

We recommend a sub-slab vapor retarder particularly in areas of the building where the concrete slab will be covered with an impermeable surface treatment or floor covering that may be sensitive to moisture vapors. The vapor retarder must have a permeance that is less than the floor cover or surface treatment that is applied to the slab. The vapor retarder must have sufficient durability to withstand direct contact with the sub-slab base material and construction activity. The vapor retarder material should be placed according to the manufacturer's recommended method, including the taping, and lapping of all joints and wall connections. The architect and/or flooring consultant should select the vapor retarder products compatible with flooring and adhesive materials.

The floor slab should be appropriately cured using moisture retention methods after casting. Typical floor slab curing methods should be used for at least 7 days. The architect or flooring consultant should assign curing methods consistent with current applicable American Concrete Institute (ACI) procedures with consideration of curing method compatibility to proposed surface treatments, flooring, and adhesive materials.

4.7 Entrance Slabs and Sidewalks

Entrance slabs and sidewalks adjacent to the building must be designed to reduce the effects of differential frost action between adjacent pavement, doorways, and entrances. We recommend that non-frost susceptible Structural Fill be provided to a depth of at least

4.5 feet below the top of entrance slabs. This thickness of Structural Fill should extend the full footprint (length and width) of the entrance slab, thereafter, transitioning up to the bottom of the adjacent sidewalk or pavement gravels at a 3H:1V or flatter slope. General details of this frost transition zone are shown on the "Foundation Detail Sketch" attached in Appendix B.

4.8 Fill, Backfill and Compaction

We recommend the following fill and backfill materials: recycled products must also be tested in accordance with applicable environmental regulations and approved by a qualified environmental consultant.

Granular Borrow: Fill to raise grades in building and paved areas, as well as to repair soft areas, should be sand or silty sand meeting the requirements of 2020 MaineDOT Standard Specification 703.19 Granular Borrow.

Structural Fill: Backfill for over-excavated slab areas and foundation, beneath foundations, floor slab base material, and material below exterior entrances slabs should be clean, non-frost susceptible sand and gravel meeting the gradation requirements for Structural Fill as given below:

Structural Fill	
Sieve Size	**Percent Finer by Weight**
4 inch	100
3 inch	90 to 100
¼ inch	25 to 90
No. 40	0 to 30
No. 200	0 to 6

Crushed Stone: Crushed Stone, used for below foundations and underdrain aggregate should be washed ¾-inch crushed stone meeting the requirements of 2020 MaineDOT Standard Specification 703.13 Crushed Stone ¾-Inch.

Reuse of Site Soils: The non-organic on-site soils are unsuitable for reuse in building areas but may be suitable for reuse as Common Borrow in paved and landscape areas, provided they are at a compactable moisture content at the time of reuse.

Placement and Compaction: Fill should be placed in horizontal lifts and compacted such that the desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. Loose lift thicknesses for grading, fill and backfill activities should not exceed 12 inches. We recommend fill and backfill below the building area be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557. Crushed Stone should be compacted with 3 to 5 passes of a vibratory plate compactor having a static weight of at least 500 pounds.

4.9 Weather Considerations

Construction activity should be limited during wet and freezing weather and the site soils may require drying or thawing before construction activities may continue. The contractor should anticipate the need for water to temper fills in order to facilitate compaction during dry weather. If construction takes place during cold weather, subgrades, foundations, and floor slabs must be protected during freezing conditions. Concrete and fill must not be placed on frozen soil; and once placed, the concrete and soil beneath the structure must be protected from freezing.

4.10 Design Review and Construction Testing

S.W.COLE should be retained to review the construction documents prior to bidding to determine that our earthwork and foundation recommendations have been properly interpreted and implemented.

A construction material testing and quality assurance program should be implemented during construction to observe compliance with the design concepts, plans, and specifications. S.W.COLE is available to observe earthwork activities, the preparation of foundation bearing surfaces and pavement subgrades, as well as to provide testing and IBC Special Inspection services for soils, concrete, steel, spray-applied fireproofing, fire-stopping, structural masonry and asphalt construction materials.

5.0 CLOSURE

It has been a pleasure to be of assistance to you with this phase of your project. We look forward to working with you during the construction phase of the project.

Sincerely,

S. W. Cole Engineering, Inc.



Michael St. Pierre, P.E.
Senior Geotechnical Engineer

MAS:rec

APPENDIX A

Limitations

This report has been prepared for the exclusive use of Artifex Architects-Engineers for specific application to the proposed Building Addition at the Daschlager House at 55 Capital Street in Augusta, Maine. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

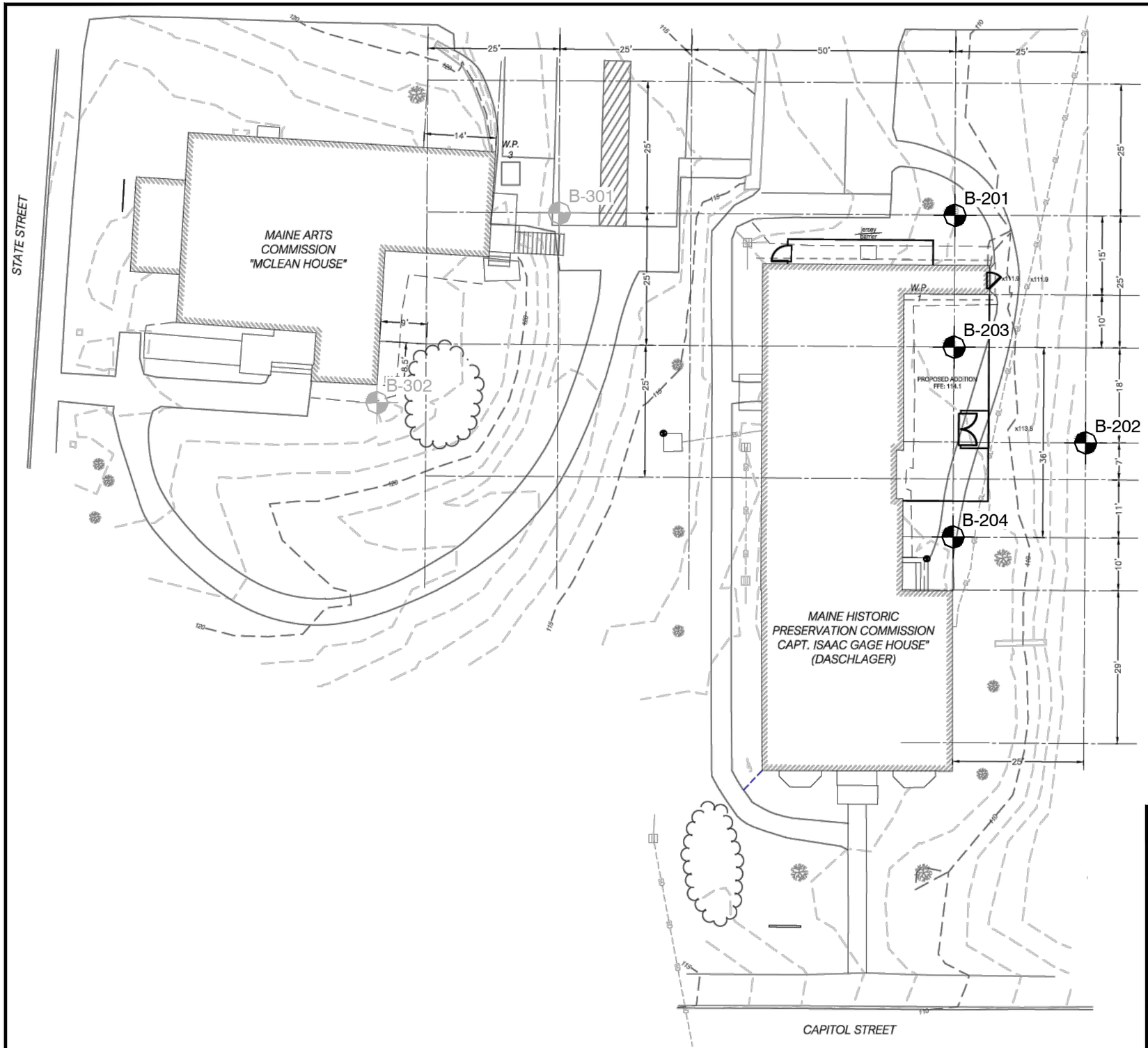
Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

S.W.COLE's scope of services has not included the investigation, detection, or prevention of any Biological Pollutants at the project site or in any existing or proposed structure at the site. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE.

APPENDIX B

Figures



LEGEND:

APPROXIMATE BORING LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=20' SCALE PLAN OF THE SITE TITLED "DASCHLAGER / MCLEAN, TEST BORING LOCATION PLAN," PREPARED BY ARTIFEX ARCHITECTS & ENGINEERS, DATED 9/14/2023.
2. THE BORING LOCATIONS WERE SELECTED BY ARTIFEX AND SUBSEQUENTLY ESTABLISHED IN THE FIELD BY S. W. COLE ENGINEERING, INC.
3. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
4. THE PURPOSE OF THIS PLAN IS ONLY TO DEPICT THE LOCATION OF THE EXPLORATIONS IN RELATION TO THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION AND IS NOT TO BE USED FOR CONSTRUCTION.

0 20 40 Feet

S.W.COLE ENGINEERING, INC.

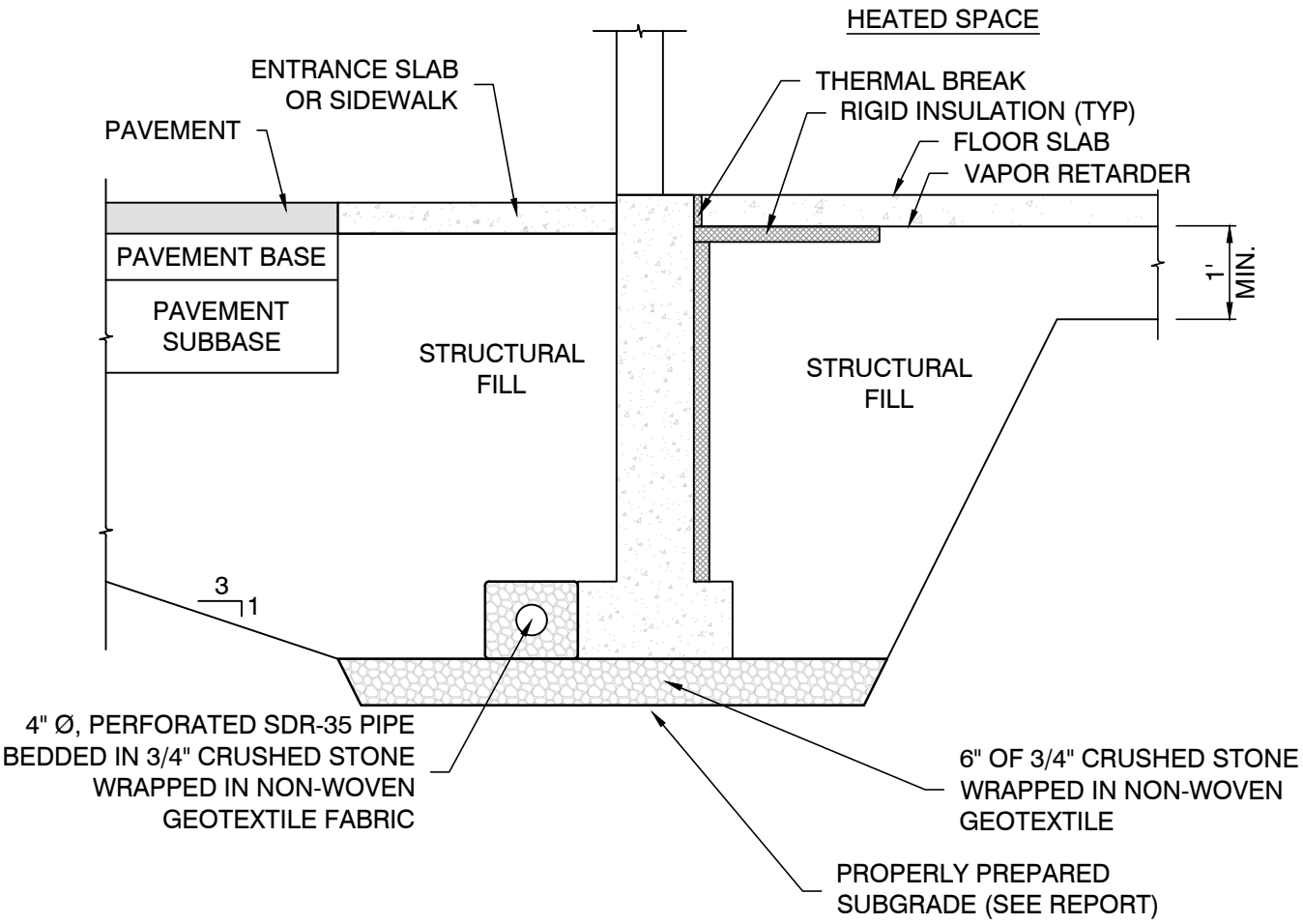
ARTIFEX ARCHITECTS & ENGINEERS

EXPLORATION LOCATION PLAN

PROPOSED BUILDING ADDITION
DASCHLAGER HOUSE
55 CAPITAL STREET, AUGUSTA, MAINE

Job No.:	23-1854-01	Scale:	1" = 20'
Date :	12/12/2023	Sheet:	1

R:\2023\23-1854\CAD\Drawings\23-1854-01 ELPs.dwg, 12/12/2023 11:23:15 AM, CEM, S. W. Cole Engineering, Inc.



NOTE:

1. UNDERDRAIN INSTALLATION AND MATERIAL GRADATION RECOMMENDATIONS ARE CONTAINED WITHIN THIS REPORT.
2. DETAIL IS PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY, NOT FOR CONSTRUCTION.

S.W.COLE ENGINEERING, INC.

ARTIFEX ARCHITECTS & ENGINEERS

FOUNDATION DETAIL SKETCH

PROPOSED BUILDING ADDITION
DASCHLAGER HOUSE
55 CAPITAL STREET, AUGUSTA, MAINE

Job No.:	23-1854-01	Scale:	Not to Scale
Date :	12/12/2023	Sheet:	2

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APPENDIX C

Exploration Logs and Key

KEY TO NOTES & SYMBOLS

Test Boring and Test Pit Explorations

Stratification lines represent the approximate boundary between soil types and the transition may be gradual.

Key to Symbols Used:

w	-	water content, percent (dry weight basis)
q_u	-	unconfined compressive strength, kips/sq. ft. - laboratory test
S_v	-	field vane shear strength, kips/sq. ft.
L_v	-	lab vane shear strength, kips/sq. ft.
q_p	-	unconfined compressive strength, kips/sq. ft. – pocket penetrometer test
O	-	organic content, percent (dry weight basis)
W_L	-	liquid limit - Atterberg test
W_P	-	plastic limit - Atterberg test
WOH	-	advance by weight of hammer
WOM	-	advance by weight of man
WOR	-	advance by weight of rods
HYD	-	advance by force of hydraulic piston on drill
RQD	-	Rock Quality Designator - an index of the quality of a rock mass.
γ_T	-	total soil weight
γ_B	-	buoyant soil weight

Description of Proportions:

Trace:	0 to 5%
Some:	5 to 12%
"Y"	12 to 35%
And	35+%
With	Undifferentiated

Description of Stratified Soils

Parting:	0 to 1/16" thickness
Seam:	1/16" to 1/2" thickness
Layer:	½" to 12" thickness
Varved:	Alternating seams or layers
Occasional:	one or less per foot of thickness
Frequent:	more than one per foot of thickness

REFUSAL: **Test Boring Explorations** - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

REFUSAL: **Test Pit Explorations** - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

BORING LOG

BORING NO.:	**B-201**
SHEET:	1 of 2
PROJECT NO.	23-1854
DATE START:	10/31/2023
DATE FINISH:	10/31/2023

CLIENT: Artifex Architects-Engineers
PROJECT: Proposed Building Renovations and Additions
LOCATION: Daschlager House, 55 Capitol Street, Augusta, Maine

Drilling Information

LOCATION: See Exploration Location Plan | **ELEVATION (FT):** 111' +/- | **TOTAL DEPTH (FT):** 32.0 | **LOGGED BY:** Bryce Walker
DRILLING CO.: S. W. Cole Explorations, LLC | **DRILLER:** Ryan Hackett | **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 | **AUGER ID/OD:** N/A / N/A | **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic | **HAMMER WEIGHT (lbs):** 140 / 140 | **CASING ID/OD:** 3 in / 3 1/2 in | **CORE BARREL:** N/A
HAMMER CORRECTION FACTOR: 1.47 | **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): ▽ 10 ft Soils appear saturated below 10 feet.
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_u = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
110			1D		0-2	24/23	1-2-2-2			0.4 5" Grassed Topsoil Very loose, brown, Silty fine SAND trace gravel; ash, wood and rootlets		Advanced with 2 1/4" Hollow Stem Augers to 10 feet.
			2D		2-4	24/15	1-1-1-1					
105	5		3D		5-7	24/24	3-5-7-6	q_P=3.0-6.0 ksf		5.0 Very stiff to stiff, brown to gray, fine Sandy Clayey SILT; occasional fine sand and silt layers/seams		
100	10		4D		10-12	24/24	2-2-2-4	q_P=2.5-3.0 ksf			▽	
95	15		5D		15-17	24/21	2-1-2-1	q_P=1.0-3.0 ksf		15.3 Medium stiff to soft, gray, Silty CLAY some fine sand; occasional silty fine sand seams		
90	20		6D		20-22	24/21	WOH-2-3-2	q_P=1.0-1.5 ksf				

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

CLIENT: Artifex Architects-Engineers
PROJECT: Proposed Building Renovations and Additions
LOCATION: Daschlager House, 55 Capitol Street, Augusta, Maine

BORING NO.: B-201
SHEET: 2 of 2
PROJECT NO. 23-1854
DATE START: 10/31/2023
DATE FINISH: 10/31/2023

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
85			7D		25-27	24/24	1-1-1-1	q_P=1.0-2.0 ksf				
	30		8D		30-32	24/24	1/12"-1/12"	q_P=0.5 ksf				
80										Bottom of Exploration at 32.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING / WELL 10-12-2022 23-1854D.GPJ SWCE TEMPLATE.GDT 12/18/23

BORING LOG

BORING NO.: B-202
SHEET: 1 of 2
PROJECT NO. 23-1854
DATE START: 10/30/2023
DATE FINISH: 10/30/2023

CLIENT: Artifex Architects-Engineers
PROJECT: Proposed Building Renovations and Additions
LOCATION: Daschlager House, 55 Capitol Street, Augusta, Maine

Drilling Information

LOCATION: See Exploration Location Plan | **ELEVATION (FT):** 106' +/- | **TOTAL DEPTH (FT):** 32.0 | **LOGGED BY:** Bryce Walker
DRILLING CO.: S. W. Cole Explorations, LLC | **DRILLER:** Ryan Hackett | **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 | **AUGER ID/OD:** N/A / N/A | **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic | **HAMMER WEIGHT (lbs):** 140 / 140 | **CASING ID/OD:** 3 in / 3 1/2 in | **CORE BARREL:** N/A
HAMMER CORRECTION FACTOR: 1.47 | **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): ▽ 10 ft Soils appear saturated below 10 feet.
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_u = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-2	24/13	3-4-3-5			12" Grassed Topsoil		Advanced with 2 1/4" Hollow Stem Augers to 10 feet.
105										1.0 Loose to medium dense, brown, Silty fine SAND trace gravel		
			2D		2-4	24/21	6-14-21-19					
										3.0 Stiff, brown to gray, fine Sandy Clayey SILT; occasional fine sand and silt layers/seams		
	5		3D		5-7	24/24	6-5-5-4					
100												
	10		4D		10-12	24/24	3-4-5-5				▽	
95												
	15		5D		15-17	24/24	2-2-2-1	q_P=0.5-1.5 ksf		15.0 Soft, gray, Silty CLAY some fine sand; rootlets and black organic seams from 25-25.5 feet		
90												
	20		6D		20-22	24/24	1-1-3-4	q_P=0.5-1.0 ksf				
85												

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

CLIENT: Artifex Architects-Engineers
PROJECT: Proposed Building Renovations and Additions
LOCATION: Daschlager House, 55 Capitol Street, Augusta, Maine

BORING NO.: B-202
SHEET: 2 of 2
PROJECT NO. 23-1854
DATE START: 10/30/2023
DATE FINISH: 10/30/2023

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
80			7D		25-27	24/24	1/12"-1-1	q_P=0.5 ksf				
	30		8D		30-32	24/24	1-1-2-2	q_P=0.5 ksf				
75										Bottom of Exploration at 32.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING / WELL 10-12-2022 23-1854D.GPJ SWCE TEMPLATE.GDT 12/18/23

BORING LOG

BORING NO.: B-203
SHEET: 1 of 2
PROJECT NO. 23-1854
DATE START: 10/31/2023
DATE FINISH: 10/31/2023

CLIENT: Artifex Architects-Engineers
PROJECT: Proposed Building Renovations and Additions
LOCATION: Daschlager House, 55 Capitol Street, Augusta, Maine

Drilling Information

LOCATION: See Exploration Location Plan | **ELEVATION (FT):** 110.5' +/- | **TOTAL DEPTH (FT):** 32.0 | **LOGGED BY:** Bryce Walker
DRILLING CO.: S. W. Cole Explorations, LLC | **DRILLER:** Ryan Hackett | **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 | **AUGER ID/OD:** N/A / N/A | **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic | **HAMMER WEIGHT (lbs):** 140 / 140 | **CASING ID/OD:** 3 in / 3 1/2 in | **CORE BARREL:** N/A
HAMMER CORRECTION FACTOR: 1.47 | **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): ▽ 10 ft Soils appear saturated below 10 feet.
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_u = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
110			1D		0-2	24/12	2-4-4-5			0.3 4" Grassed Topsoil Loose, brown, fine Sandy SILT trace gravel; ash, wood, brick and rootlets (Fill)		Advanced with 2 1/4" Hollow Stem Augers to 10 feet.
			2D		2-4	24/18	4-3-2-4					
105	5		3D		5-7	24/24	5-6-5-6	q_P=3.5-6.0 ksf ID 15295A w =21.4 %		5.0 Very stiff to stiff, brown to gray, fine Sandy Clayey SILT; occasional fine sand and silt layers/seams		
100	10		4D		10-12	24/24	2-3-2-3	q_P=1.5-3.0 ksf ID 15296A w =22.4 %			▽	
95	15		5D		15-17	24/24	3-3-2-3	q_P=1.5-3.0 ksf		17.0 Soft, gray, Silty CLAY some fine sand		
90	20		6D		20-22	24/24	1-2-1-1	q_P=0.5-1.0 ksf				

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

CLIENT: Artifex Architects-Engineers
PROJECT: Proposed Building Renovations and Additions
LOCATION: Daschlager House, 55 Capitol Street, Augusta, Maine

BORING NO.: B-203
SHEET: 2 of 2
PROJECT NO. 23-1854
DATE START: 10/31/2023
DATE FINISH: 10/31/2023

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
85			7D		25-27	24/16	1-2-1-1	q_P=0.5-1.0 ksf				
	30											
80			8D		30-32	24/24	WOH-1-1-2	q_P=0.5-1.0 ksf				
										31.0 Very loose, gray to brown, SILT and fine SAND some clay; seashell fragments and black organic seams		
										Bottom of Exploration at 32.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING / WELL 10-12-2022 23-1854D.GPJ SWCE TEMPLATE.GDT 12/18/23

BORING LOG

BORING NO.: B-204
SHEET: 1 of 2
PROJECT NO. 23-1854
DATE START: 10/30/2023
DATE FINISH: 10/30/2023

CLIENT: Artifex Architects-Engineers
PROJECT: Proposed Building Renovations and Additions
LOCATION: Daschlager House, 55 Capitol Street, Augusta, Maine

Drilling Information

LOCATION: See Exploration Location Plan | **ELEVATION (FT):** 112' +/- | **TOTAL DEPTH (FT):** 32.0 | **LOGGED BY:** Bryce Walker
DRILLING CO.: S. W. Cole Explorations, LLC | **DRILLER:** Ryan Hackett | **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 | **AUGER ID/OD:** N/A / N/A | **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic | **HAMMER WEIGHT (lbs):** 140 / 140 | **CASING ID/OD:** 3 in / 3 1/2 in | **CORE BARREL:** N/A
HAMMER CORRECTION FACTOR: 1.47 | **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): ▽ 15 ft Soils appear saturated below 15 feet.
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_u = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
110			1D		0.5-2.5	24/4	3-3-1-1			0.3 3" Asphalt Loose, brown, Silty fine SAND trace gravel; occasional bricks (Fill)		Advanced with 2 1/4" Hollow Stem Augers to 10 feet.
			2D		2.5-4.5	24/12	2-2-2-1					
	5		3D		5-7	24/22	2-3-3-5	q_P=4.0-6.0 ksf		6.2 Loose, brown to gray, fine Sandy Clayey SILT; occasional fine sand and silt layers/seams		
105												
	10		4D		10-12	24/22	3-3-3-2	q_P=3.5-4.0 ksf				
100												
	15		5D		15-17	24/24	3-4-3-2	q_P=2.0-3.5 ksf			▽	
										15.7 Soft, gray, Silty CLAY some fine sand; occasional seashell fragments and black organic seams below 30'		
95												
	20		6D		20-22	24/24	1-1-1-1	q_P=1.0-1.5 ksf				
90												

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

CLIENT: Artifex Architects-Engineers
PROJECT: Proposed Building Renovations and Additions
LOCATION: Daschlager House, 55 Capitol Street, Augusta, Maine

BORING NO.: B-204
SHEET: 2 of 2
PROJECT NO. 23-1854
DATE START: 10/30/2023
DATE FINISH: 10/30/2023

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			7D		25-27	24/24	1-1/12"-1	q_P=0.5-1.0 ksf				
85												
	30		8D		30-32	24/24	WOH/12"-1-1	q_P=0.5 ksf				
80										Bottom of Exploration at 32.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING / WELL 10-12-2022 23-1854D.GPJ SWCE TEMPLATE.GDT 12/18/23

00 41 13
Contractor Bid Form

Daschlager House Renovation Project BGS 3560

Bid Form submitted by: *email only to email address below*

Bid Administrator:
Paul R. Barber 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 *Daschlager House Renovation* Project Manual dated *18 February 2026*, prepared by *Artifex Architects & Engineers*, 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:

   $ _____ .00

2. Allowances *are included* on this project.

   1 250 Square Feet of Masonry Remediation $ _____ .00

3. Alternate Bids *are included* on this project.
   Alternate Bids are as shown below.
   Any dollar amount line below that is left blank by the Bidder shall be read as a bid of **$0.00**.

   1 Desk at Reception Area. $ _____ .00

   2 Single Entry Door at Vestibule, plus 2 sidelites. $ _____ .00

   3 High Density Storage. $ _____ .00

   4 Patch/Repair Plaster Walls & Ceilings in Rms 207 and 210. $ _____ .00

   5 In Ground Floor Rooms not included in Finish Schedule: Paint all walls, ceilings, trim, and doors. $ _____ .00

   6 In Second Floor Rooms not included in Finish Schedule: Paint all walls, ceilings, trim, and doors. $ _____ .00

   7 Paint all Third Floor Rooms: Paint all walls, ceilings, trim, and doors. (Note: Third floor not included in Finish Schedule.) $ _____ .00

   8 At Ground Floor Rooms not receiving new floor finish, remove existing carpeting, dispose, polish/buff existing wood floors beneath removed carpeting. $ _____ .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.

SAMPLE

[Fillable bond forms may be downloaded from the Bureau of General Services website.]

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 same date as that of 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.

SAMPLE

[Fillable bond forms may be downloaded from the Bureau of General Services website.]

DOCUMENT 00 43 22 - UNIT PRICES FORM

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: Daschlager House Renovation.

C. Project Location: Augusta, Maine

D. Owner: State of Maine, Bureau of General Services (BGS)

E. Owner Project Number: 3561 and 3562.

F. Architect: Ames Associates, LLC dba Artifex AE.

G. Architect Project Number: 2022147

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

B. The undersigned Bidder proposes the amounts below be added to or deducted from the Contract Sum on performance and measurement of the individual items of Work and for adjustment of the quantity given in the Unit-Price Allowance for the actual measurement of individual items of the Work.

1.3 UNIT PRICES.

A. Unit-Price No. 1: Historic Masonry remediation/repointing.

1. _____dollars ($_____) per square foot.

1.4 SUBMISSION OF BID SUPPLEMENT

A. Respectfully submitted this ____ day of _____, 2025.

B. Submitted By:_____(Insert name of bidding firm or corporation).

C. Authorized Signature:_____(Handwritten signature).

D. Signed By:_____(Type or print name).

E. Title:_____(Owner/Partner/President/Vice President).

END OF DOCUMENT 00 43 22

AdvantageME CT# _____

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 ***contracting entity name*** hereinafter called the ***Owner*** and ***Contractor company name*** hereinafter called the ***Contractor***.

BGS Project No.: ***number assigned by BGS*** Other Project No.: _____

For the following Project: ***title of project as shown on bid documents*** at ***facility or campus name***, ***municipality***, Maine.

The Specifications and the Drawings have been prepared by ***Consultant firm name***, 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	*$0.00*
Alternate Bid number and name or "no Alternates"	*$0.00*
Alternate Bid number and name or "no Alternates"	*$0.00*
Alternate Bid number and name or "no Alternates"	*$0.00*
Alternate Bid number and name or "no Alternates"	*$0.00*
Alternate Bid number and name or "no Alternates"	*$0.00*
Total Contract Amount	***$0.00***

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 _____.

SAMPLE

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

2.4 The Contract Expiration Date shall be _____. (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.

SAMPLE

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"***

SAMPLE

BGS Project No.: _____

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.

select proper approval authority	
Reviewed by:	**Approved by:**
Signature *Date* *insert name*	*Signature* *Date* *John Kenney, P.E.*
Project Manager/ Contract Administrator	*Director, Planning Design and Construction Division (PDCD)*

SAMPLE

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.

SAMPLE

[Fillable bond forms may be downloaded from the Bureau of General Services website.]

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.

SAMPLE

[Fillable bond forms may be downloaded from the Bureau of General Services website.]

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.

SAMPLE

[Fillable bond forms may be downloaded from the Bureau of General Services website.]

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.

SAMPLE

[Fillable bond forms may be downloaded from the Bureau of General Services website.]

Form revision date: 12 May 2023

AdvantageME CT# 00000000000000000000

State of Maine
CONSTRUCTION CONTRACT
Application for Payment

Three State Building Renovations
State Capitol/Augusta, Maine

Contractor Company name
address
city state zip code

Application Number: **1**
Period Start Date: 1-Jul-2020
Period End Date: 31-Jul-2020
BGS Project No.: n
Other Project No.: x

1	Original Contract Amount			$0
2	Net of Change Orders to Date	(from table below)		$0
3	Contract Sum to Date	(line 1 plus or minus line 2)		$0
4	Total Completed and Stored to Date	(column G on Continuation Sheet)		$0
5a	5% Retainage of Completed Work	(columns D + E x 5%)	$0	
5b	5% Retainage of Stored Materials	(column F x 5%)	$0	
5c	Total Retainage	(column I)		$0
6	Total Earned Less Retainage	(line 4 minus line 5c)		$0
7	Less Previous Approved Applications for Payment	(line 6 from previous Application)		$0
8	Current Payment Due	(line 6 minus line 7)		**$0**
9	Balance to Finish, Including Retainage	(line 3 minus line 6)	$0	

Change Order Summary	Additions	Deductions	
Total Changes Approved in Previous Months	$0	$0	
Total Changes Approved this Month	$0	$0	
Subtotals	$0	$0	
Net of Change Orders to Date			$0

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information, and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which the previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

Contractor
Type company name here
Type person's name, title here

signature date

In accordance with the Contract Documents, based on on-site observations and the data comprising this Application, the Consultant certifies to the Owner that to the best of the Consultant's knowledge, information, and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the Amount Certified. **Amount Certified:** _____

Consultant (Architect or Engineer)
Artifex AE
Ellen Angel, Architect

signature date

Owner
Bureau of General Services
Type person's name, title here

signature date

Owner's Rep / other - clear this text if not used
Type entity name here
Type person's name, title here

signature date

Bureau of General Services

Deane Rykerson

signature date

Form revision date: 12 May 2023

State of Maine
CONSTRUCTION CONTRACT
Application for Payment - Continuation Sheet

Three State Building Renovations

Contractor Company name

Application Number: **1**
Period Start Date: 1-Jul-2020
Period End Date: 31-Jul-2020
BGS Project No.: n
Other Project No.: x

A	B	C	D	E	F	G		H	I
Item No.	Description of Work	Scheduled Value	Work Completed From Previous Application (Previous D + E)	Work Completed From This Period	Total Stored Materials (Not in D or E)	Total Completed and Stored to Date (D + E + F)	Percent Complete (G ÷ C)	Balance to Finish (C - G)	Retainage 5%
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
		$0	0	0	0	0	0.0%	$0	0
	Total	$0	$0	$0	$0	$0	0.0%	$0	$0

revised 05 April 2021

State of Maine
CONSTRUCTION CONTRACT
Construction Change Directive

Three State Building Renovations
State Capitol, Augusta, Maine

C. C. D. Number: **1**
CP (Change Proposal) Number 1
Issue Date of this Document: 31-Oct-2021

Contractor Company name
address
city state zip code

BGS Project No.: n
Other Project No.: x

CCD Item	Type name of CCD item here		
Description of Work	Type brief description here of work scope here.		
Reason or Necessity of Work	Type brief justification for change here.		
Method of Compensation	Select from drop down box…	**Projected Total Cost**	$0
Supporting Documentation	is attached	**Projected Calendar Days***	0

** Calendar Days refers to Contract Final Completion Date only.*
Fully describe the scope of work of the CCD item in the table above and on attached drawings and specifications as necessary.
Indicate the reason for the work, and the estimated schedule and cost impacts.
This CCD records the order to do the work. The documented actual final time and cost changes are subject to approval in a subsequent Change Order process.

Consultant (Architect or Engineer)
Artifex AE
Ellen Angel, Architect
signature date

Contractor
Type company name here
Type person's name, title here
signature date

Owner
Bureau of General Services
Type person's name, title here
signature date

Owner's Rep
Type entity name here
Type person's name, title here
signature date

Bureau of General Services
Division of Planning, Design & Construction
Deane Rykerson
signature date

revised 05 April 2021

State of Maine Change Order

List of Change Order Items

Project name
Contractor Company name

C. O. Number: 1

CO Item No.	CP No.	Item Name	Reason Code	Calendar Days*	Cost
1	1	Type brief name of Change Order Item here		0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
				0	$0
			Totals	**0**	**$0**

Reason Codes

EO Error or omission of Consultant
UC Unforeseen job site condition
OC Owner-generated change
RC Regulatory authority-generated change
CC Contractor-generated change

** Calendar Days shows Contract Final Completion Date impact only.*

Attach this sheet to the BGS "Change Order" cover sheet (with cost and time summaries, and signatures). Attach a "Details" sheet, and other supporting documentation, for each Change Order Item listed above.

revised 05 April 2021

State of Maine Change Order

Details of Change Order Item

Project name
location / school / campus

Change Order Item Number **1**
CP (Change Proposal) Number 1
Issue Date of this Document: 31-Oct-2021

Contractor Company name
address
city state zip code

BGS Project No.: n
Other Project No.: x

Change Order Item	Type name of Change Order Item here			
Description of Work	Type brief description here of work scope here.			
Reason or Necessity of Work	Type brief justification for change here.			
Cost Breakdown	Work by Subcontractor only	Work by Sub *and* Contractor	Work by Contractor only	
Subcontractor base cost	$0	$0		
Subcontractor markup	$0	$0		
Contractor base cost		$0	$0	
Contractor markup	$0	$0	$0	
Subtotal	$0	$0	$0	
Compensation	lump sum		**Total Cost**	**$0**
Initiated by	Consultant		**Calendar Days***	0
Reason Code	CC	**Supporting Documentation**		is attached

EO — *Error or omission of Consultant*
UC — *Unforeseen job site condition*
OC — *Owner-generated change*
RC — *Regulatory authority-generated change*
CC — *Contractor-generated change*

** Calendar Days shows Contract Final Completion Date impact only.*

Consultant
(Architect or Engineer)
Type firm name here
Type person's name, title here
signature date

Contractor
Type company name here
Type person's name, title here
signature date

Owner
Type contracting entity name here
Type person's name, title here
signature date

Owner's Rep
Type entity name here
Type person's name, title here
signature date

Bureau of
Division of Planning, Design & Construction

General Services Type person's name, title here

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signature date

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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.

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*.

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

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;

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.

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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General Conditions

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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.

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).

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

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

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

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

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.

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

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.

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.

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.

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.

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.

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

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.

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,

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

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

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.

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.

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.

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)

00 73 46
Wage Determination Schedule

THIS DOCUMENT MUST BE CLEARLY POSTED AT ALL CONSTRUCTION SITES FUNDED IN PART WITH STATE FUNDS

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.

2026 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	$43.91	$28.47	$72.38
Bulldozer Operator	$30.62	$5.38	$36.00
Carpenter	$27.70	$10.15	$37.85
Cement Masons and Concrete Finisher	$27.44	$0.87	$28.31
Construction and Maintenance Painters	$29.16	$3.32	$32.48
Construction Laborer	$25.32	$2.04	$27.36
Conveyor Operators and Tenders	$30.17	$13.77	$43.94
Crane and Tower Operators	$40.43	$8.63	$49.06
Crushing Grinding and Polishing Machine Operators	$26.15	$3.24	$29.39
Earth Drillers - Except Oil and Gas	$25.04	$3.77	$28.81
Electrical Power - Line Installer and Repairers	$48.12	$15.63	$63.75
Electricians	$36.22	$19.40	$55.62
Elevator Installers and Repairers	$67.34	$39.76	$107.10
Excavator Operator	$34.12	$6.49	$40.61
Fence Erectors	$30.90	$2.18	$33.08
Flaggers	$21.39	$0.86	$22.25
Floor Layers - Except Carpet/Wood/Hard Tiles	$29.00	$8.65	$37.65
Glaziers	$39.32	$19.22	$58.54
Hazardous Materials Removal Workers	$24.12	$1.60	$25.72
Heating and Air Conditioning and Refrigeration Mechanics and Installers	$34.53	$5.29	$39.82
Heavy and Tractor - Trailer Truck Drivers	$29.13	$3.98	$33.11
Highway Maintenance Workers	$23.30	$1.14	$24.44
Industrial Machinery Mechanics	$29.97	$6.74	$36.71
Industrial Truck and Tractor Operators	$24.61	$4.21	$28.82
Insulation Worker - Mechanical	$27.35	$6.05	$33.40
Light Truck or Delivery Services Drivers	$26.79	$5.14	$31.93
Loading Machine and Dragline Operators	$29.71	$4.79	$34.50
Millwrights	$35.99	$10.52	$46.51
Mobile Heavy Equipment Mechanics - Except Engines	$30.67	$5.10	$35.77
Operating Engineers and Other Equipment Operators	$39.74	$3.67	$43.41
Paving Surfacing and Tamping Equipment Operators	$30.74	$10.67	$41.41
Pile-Driver Operators	$37.15	$3.12	$40.27
Pipe/Steam/Sprinkler Fitter	$31.38	$8.02	$39.40
Pipelayers	$28.75	$3.64	$32.39
Plumbers	$31.30	$6.35	$37.65
Radio Cellular and Tower Equipment Installers	$34.72	$5.63	$40.35

Reinforcing Iron and Rebar Workers	$32.94	$25.00	$57.94
Riggers	$31.25	$7.68	$38.93
Roofers	$22.93	$4.35	$27.28
Sheet Metal Workers	$27.85	$6.44	$34.29
Structural Iron and Steel Workers	$28.22	$4.33	$32.55
Tapers	$29.16	$5.64	$34.80
Telecommunications Equipment Installers and Repairers - Except Line Installers	$43.59	$21.08	$64.67
Telecommunications Line Installers and Repairers	$28.49	$5.29	$33.78
Tile and Marble Setters	$28.91	$5.46	$34.37

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

Supersedes 02-03-2025
Effective 01-10-2026

End of Section 00 73 46

SECTION 01 10 00 - 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. Phased construction.
4. Contractor's use of site and premises.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.
8. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

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: Three State Buildings.

1. Project Location: Daschlager House, 55 Capitol Street, Augusta, Maine

B. Owner: State of Maine.

1. Owner's Representative: Paul Barber.

C. Architect: Artifex Architects and Engineers, 175 Exchange Street, Bangor, Maine

1. Architect's Representative: Ellen Angel, Architect, eangel@artifexae.com

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Mechanical, Electrical, and Fire Suppression Engineering: The Colby Engineering Company

a. Representative: Ben Townsend.

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. Renovations at the Daschlager House, 55 Capitol Street, Augusta, Maine.
2. A variety of building system upgrades, including the building envelope; restoration of select historic elements; and limited interior alterations.
3. A building additions for archival storage and for Accessibility including a new elevator.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. 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.

B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits 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 area designated on drawings as “Limits of Work”.
2. Driveways, Walkways and Entrances: Keep driveways 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.

C. 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.

D. 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.

1.7 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will not occupy the premises during entire construction period, with the exception of minimal access as required. 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.

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.

1.8 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 a.m. to 5 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: none
2. Early Morning Hours: None before 7 a.m..

C. On-Site Work Day Restrictions: Do not perform work resulting in utility shutdowns or resulting in noisy activity on-site during work black-out days indicated in Document 003113 "Preliminary Schedules."

D. 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 Owner not less than two days in advance of proposed utility interruptions.

E. 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 Owner not less than two days in advance of proposed disruptive operations.

F. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

H. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.9 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 scheduled on Drawings.

1.10 MISCELLANEOUS PROVISIONS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

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 governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Unit-cost allowances.
3. Quantity allowances.
4. Contingency allowances.
5. Testing and inspecting allowances.

C. Related Requirements:

1. Section 012200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.
2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
3. Section 014000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.3 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

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C. Purchase products and systems selected by Architect from the designated supplier.

1.5 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include freight**,** and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.8 UNIT-COST ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include freight**,** and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.9 QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

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1.10 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's **overhead, profit, and** related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.11 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of testing and inspection services not specifically required by the Contract Documents are Contractor responsibilities and are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.12 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

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5. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
6. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Quantity Allowance: Include 250 Square Feet of Masonry remediation at Daschlager House.

1. Coordinate quantity allowance adjustment with unit-price requirements in Section 01 22 00 "Unit Prices."

END OF SECTION 01 21 00

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SECTION 01 22 00 - 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 012100 "Allowances" for procedures for using unit prices to adjust quantity allowances.
2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as 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, 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.

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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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit-Price No. 1: Historic Masonry remediation/repointing.

1. Description: Repointing and any required masonry restoration or exterior walls per Specifications Sections 04 03 10 HISTORIC MASONRY CLEANING; 04 03 23 HISTORIC BRICK UNIT MASONRY REPOINTING; and 04 20 00 UNIT MASONRY
2. Unit of Measurement: Square foot of area of masonry wall based on in-place surveys of area before and after work.
3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 21 00 "Allowances."

END OF SECTION 01 22 00

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SECTION 01 23 00 - ALTERNATES

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 alternates.

1.3 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.

1.4 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: Desk at Reception Area

1. Base Bid: Stub up all electrical and security connections to floor box. Finishes as shown
2. ADD Alternate: Construction and installation of Reception Desk per plans as indicated on Drawing A-A405.

B. Alternate No. 2: Single Entry Door at Vestibule plus 2 sidelites.

1. Base Bid: Double Entry Doors
2. ADD/DEDUCT Alternate: Replace double doors with Single door of same size as one door plus 2 sidelites (one each side).

C. Alternate No. 3: High Density Storage.

1. Base Bid: Prep in Archive space for future system
2. ADD Alternate: Install High Density Storage System in Archive Room (first floor).

D. Alternate No. 4: Plaster Repair

1. Base Bid: As indicated on Drawings
2. ADD Alternate: Patch & Repair Plaster Walls & Ceilings in Rooms 207 and 210.

E. Alternate No. 5: Ground Floor Painting

1. Base Bid: As indicated on Drawings & Finish Schedule
2. ADD Alternate: Paint all walls, ceilings, trim, and doors at Ground Floor not included in Finish Schedule.

F. Alternate No. 6: Second Floor Painting

1. Base Bid: As indicated on Drawings & Finish Schedule
2. ADD Alternate: Paint all walls, ceilings, trim, and doors at Second Floor not included in Finish Schedule.

G. Alternate No. 7: Third Floor Painting

1. Base Bid: As indicated on Drawings & Finish Schedule
2. ADD Alternate: Paint all walls, ceilings, trim, and doors at Third Floor.

H. Alternate No. 8: Flooring at Ground Floor

1. Base Bid: As indicated on Drawings & Finish Schedule
2. ADD Alternate: Remove existing carpeting, dispose, polish/buff existing wood floors beneath removed carpeting at Ground Floor Rooms not receiving new floor finish.

I.

END OF SECTION 01 23 00

SECTION 01 25 00 - 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 01 23 00 "Alternates" for products selected under an alternate.
   2. Section 01 60 00 "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. 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.
      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.
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.

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.

C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

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 offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Substitution request is fully documented and properly submitted.

e. Requested substitution will not adversely affect Contractor's construction schedule.
f. Requested substitution has received necessary approvals of authorities having jurisdiction.
g. Requested substitution is compatible with other portions of the Work.
h. Requested substitution has been coordinated with other portions of the Work.
i. Requested substitution provides specified warranty.
j. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 26 00 - 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 AIA Document G710.

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 time specified in Proposal Request or 20 days, when not otherwise specified, 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

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 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 01 21 00 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 01 22 00 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 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 AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. 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.

1.8 WORK CHANGE DIRECTIVE

A. Work Change Directive: Architect may issue a Work Change Directive. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Work 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 Work Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - 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. Document 00 43 73 "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
2. Section 01 21 00 "Allowances" for procedural requirements governing the handling and processing of allowances.
3. Section 01 22 00 "Unit Prices" for administrative requirements governing the use of unit prices.
4. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
5. Section 01 32 00 "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.
3. .

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.
    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. 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.

4. 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.

5. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.

6. 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.

7. 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.

8. 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.

9. 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.

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. Application for Payment Forms: Use 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.

D. 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.

E. 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.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. 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.

G. 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.

H. 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. Products list (preliminary if not final).
5. Sustainable design action plans, including preliminary project materials cost data.
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Report of preconstruction conference.
14. Data needed to acquire Owner's insurance.

I. 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.

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.

J. 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. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - 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. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Related Requirements:

1. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
2. Section 01 77 00 "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. 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.

B. 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.

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. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    e. Indicate required installation sequences.
    f. 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, 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 sub-framing 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.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts 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 in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.

c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

a. Locations 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.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:

1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.

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.
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: AIA Document G716.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven 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 01 26 00 "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.

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 seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Architect's Data Files Not Available: Architect will not provide Architect's CAD drawing digital data files for Contractor's use during construction.

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.

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: Entity responsible for conducting meeting 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: Architect will 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.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

4. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent and sustainable design coordinator; 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.

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 90 days prior to the scheduled date of Substantial Completion.

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. Owner's partial occupancy requirements.
    l. Installation of Owner's furniture, fixtures, and equipment.
    m. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at monthly 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.
        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: Entity responsible for conducting the meeting 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 biweekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. 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 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.
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 01 31 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 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 01 77 00 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 02 41 16 "Structure Demolition" for photographic documentation before building demolition operations commence.
3. Section 02 41 19 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. 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.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos via email, electronic transfer, or on CD-ROM or thumb-drive. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file metadata tag:

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.

1.3 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 from camera.

D. File Names: Name media files with date and sequential numbering suffix.

1.4 CONSTRUCTION PHOTOGRAPHS

A. 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.

B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.

1. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
2. Take 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

C. Periodic Construction Photographs: Take 20 photographs monthly. Select vantage points to show status of construction and progress since last photographs were taken.

D. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

E. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:

a. Special events planned at Project site.
b. Immediate follow-up when on-site events result in construction damage or losses.

c. Photographs are to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
d. Substantial Completion of a major phase or component of the Work.
e. Extra record photographs at time of final acceptance.
f. Owner's request for special publicity photographs.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 33

SECTION 01 33 00 - 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 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

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. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. 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.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

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.

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.

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.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
4. Resubmittals requiring review by the Architect, in excess of the first resubmittal, will be at an Additional Service to the Contractor.

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 approval 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.

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.
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 (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).

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. 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.

5. 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.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample set, one will be retained by owner and all remainder will be returned.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

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:

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.
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.

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.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

1. PDF Submittals: Architect and Construction Manager will indicate, via markup on each submittal, the appropriate action.

2. Paper Submittals: Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate 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 discard 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 013300

SECTION 01 35 91 - HISTORIC TREATMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general protection and treatment procedures for designated historic spaces, areas, rooms, and surfaces in Project.

1.2 DEFINITIONS

A. Consolidate: To strengthen loose or deteriorated materials in place.

B. Design Reference Sample: A sample that represents Architect's prebid selection of work to be matched; it may be existing work or work specially produced for Project.

C. Dismantle: To disassemble or detach a historic item from a surface, or a nonhistoric item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

D. Historic: Spaces, areas, rooms, surfaces, materials, finishes, and overall appearance that are important to the successful rehabilitation as determined by Architect. Designated historic surfaces are indicated on Drawings.

1. **Renovation Zones**: Areas of significant architectural importance, integrity, and visibility; to be preserved and restored consistent with the remaining historic fabric and to the extent indicated on Drawings.
2. **Alteration Zones**: Areas of slight architectural importance, integrity, and visibility; to leave any remaining original fabric untouched insofar as is consistent with accommodating modern uses for the building as indicated on Drawings.

E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

G. Reinstall: To protect removed or dismantled item, repair and clean it as indicated for reuse, and reinstall it in original position, or where indicated.

H. Remove: To take down or detach a non-historic item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

I. Repair: To correct damage and defects, retaining existing materials, features, and finishes while employing as little new material as possible. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

J. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

K. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

L. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

M. Restore: To consolidate, replicate, reproduce, repair, and refinish as required to achieve the indicated results.

N. Retain: To keep an element or detail secure and intact.

O. Reversible: New construction work, treatments, or processes that can be removed or undone in the future without damaging historic materials unless otherwise indicated.

P. Salvage: To protect removed or dismantled items and deliver them to Owner ready for reuse.

Q. Stabilize: To provide structural reinforcement of unsafe or deteriorated items while maintaining the essential form as it exists at present; also, to reestablish a weather-resistant enclosure.

R. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 PROJECT MEETINGS FOR HISTORIC TREATMENT

A. Preliminary Historic Treatment Conference: Before starting historic treatment work, Architect will conduct conference at Project site.

1. Attendees: In addition to representatives of Owner, Architect, and Contractor, testing service representative, historic treatment specialists, chemical-cleaner manufacturer(s), and installers whose work interfaces with or affects historic treatment shall be represented at the meeting.
2. Agenda: Discuss items of significance that could affect progress of historic treatment work, including review of the following:

    a. Fire-prevention plan.
    b. Governing regulations.
    c. Areas where existing construction is to remain and the required protection.
    d. Sequence of historic treatment work operations.
    e. Storage, protection, and accounting for salvaged and specially fabricated items.
    f. Existing conditions, staging, and structural loading limitations of areas where materials are stored.

3. Reporting: Record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

B. Coordination Meetings: Conduct for historic treatment work at monthly intervals.

1. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of historic treatment work. Include topics for discussion as appropriate to status of Project.

2. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.4 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

1.5 INFORMATIONAL SUBMITTALS

A. Historic Treatment Program: Submit within 30 days before work begins.

B. Fire-Prevention Plan: Submit 30 days before work begins.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: An experienced firm regularly engaged in historic treatments similar in nature, materials, design, and extent to the work as specified in each Section and that has completed a minimum of five recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.

1. Field Supervisor Qualifications: Full-time supervisors experienced in historic treatment work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on site when historic treatment work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond control of the specialist firm.

B. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.

C. Historic Treatment Program: Prepare a written plan for historic treatment for whole Project exterior, including each phase or process and protection of surrounding materials during operations. Describe in detail the materials, methods, and equipment to be used for each phase of work. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project historic treatment program with specific requirements of programs required in other historic treatment Sections.

1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

D. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during

each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.

E. Safety and Health Standard: ANSI/ASSP A10.6.

1.7 STORAGE AND HANDLING OF HISTORIC MATERIALS

A. Identification: Photograph, tag, and catalog historic items to be salvaged or reinstalled.

1. Identify each item with a nonpermanent location identification tag indicating item name or use, location, and location identification number to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying tag.

    a. For groups of material such as brick, provide location identification tag for pallet or container. Do not tag individually.

B. Salvaged Historic Materials:

1. Clean loose dirt and debris from salvaged historic items unless more extensive cleaning is indicated.
2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during storage.

C. Historic Materials for Reinstallation:

1. Repair and clean historic items for reuse as indicated.
2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

D. Existing Historic Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after historic treatment and construction work in the vicinity is complete.

E. Storage: Store historic items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

1. Secure stored materials to protect from theft.
2. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F (3 deg C) or more above the dew point.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from historic treatment procedures.

1. Use only proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where historic treatment work is being performed.
3. Erect temporary barriers to form and maintain fire-egress routes.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during historic treatment work.
5. Contain dust and debris generated by historic treatment work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
8. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.

B. Temporary Protection of Historic Materials:

1. Protect existing historic materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to historic surfaces except as indicated as part of the historic treatment program and approved by Architect.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:

1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by historic treatment work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for historic treatment work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.

1. Prevent solids such as stone or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from historic treatment work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

F. Existing Roofing: Prior to the start of work in an area, install roofing protection adjacent to areas of new construction.

3.2 PROTECTION FROM FIRE

A. Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated.
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.

    a. If combustible material cannot be removed, provide fire blankets to cover such materials.

3. Prohibit smoking by all persons within Project work and staging areas .

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of welding or other high-heat equipment. Use of open-flame equipment is not permitted. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:

    a. Train each fire watch in proper operation of fire-control equipment and alarms.
    b. Prohibit fire-watch personnel from other work that would distract from fire-watch duties.
    c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.

d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
e. Maintain fire-watch personnel at Project site until 60 minutes after conclusion of daily work.

C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for type of fire risk in each work area. Ensure that nearby personnel and fire-watch personnel are trained in fire-extinguisher and blanket use.

D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.

1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.

B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in historic treatment program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.

D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.

E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL HISTORIC TREATMENT

A. Have historic treatment work performed only by qualified historic treatment specialists.

B. Ensure that supervisory personnel are present when historic treatment work begins and during its progress.

C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs. Comply with requirements in Section 013233 "Photographic Documentation."

D. Perform daily inspections of Project site as the Work progresses to detect hazards resulting from historic treatment procedures.

E. Follow the procedures in subparagraphs below and procedures approved in historic treatment program unless otherwise indicated:

1. Retain as much existing material as possible; repair and consolidate rather than replace.
2. Use additional material or structure to reinforce, strengthen, prop, tie, and support existing material or structure.
3. Use reversible processes wherever possible.
4. Use historically accurate repair and replacement materials and techniques unless otherwise indicated.
5. Record existing work before each procedure (preconstruction) and progress during the work with digital preconstruction documentation photographs or video recordings. Comply with requirements in Section 013233 "Photographic Documentation."

F. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.

1. Do not proceed with the work in question until directed by Architect.

G. Where missing features are indicated to be repaired or replaced, provide work with appearance based on accurate duplications rather than on conjecture, subject to approval of Architect.

H. Where work requires existing features to be removed or dismantled and reinstalled, perform these operations without damage to the material itself, to adjacent materials, or to the substrate.

I. Identify new and replacement materials and features with permanent marks hidden in the completed Work to distinguish them from original materials. Record a legend of identification marks and the locations of the items on record Drawings.

END OF SECTION 01 35 91

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 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, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Requirements:

1. Section 012100 "Allowances" for testing and inspection allowances.

1.2 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.

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) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with 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.

1.3 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 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.

1.4 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.

1.5 ACTION SUBMITTALS

A. Mockup Shop Drawings:

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. 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.

D. 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.

E. 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.
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.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. 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 of Award, 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.
3. Owner-performed tests and inspections indicated in the Contract Documents.

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.

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.

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. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. 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.

G. 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.

H. 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.

I. 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.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor's Responsibilities:

    a. Provide test specimens representative of proposed products and construction.
    b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. 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.
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.

    a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

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 and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect 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.
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. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. 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 and testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.

3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

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 and 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 01 40 00

SECTION 01 42 00 - 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.

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. 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.
2. AAMA - American Architectural Manufacturers Association; (see FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; www.concrete.org.
9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
12. AF&PA - American Forest & Paper Association; www.afandpa.org.
13. AGA - American Gas Association; www.aga.org.
14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
16. AI - Asphalt Institute; www.asphaltinstitute.org.
17. AIA - American Institute of Architects (The); www.aia.org.
18. AISC - American Institute of Steel Construction; www.aisc.org.
19. AISI - American Iron and Steel Institute; www.steel.org.
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
23. ANSI - American National Standards Institute; www.ansi.org.
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - APA - The Engineered Wood Association; www.apawood.org.
26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.

29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; 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.
33. ASME - ASME International; American Society of Mechanical Engineers (The); www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; www.bwfbadminton.com.
50. CARB - California Air Resources Board; www.arb.ca.gov.
51. CDA - Copper Development Association Inc.; www.copper.org.
52. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
53. CEA - Canadian Electricity Association; www.electricity.ca.
54. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
55. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
56. CGA - Compressed Gas Association; www.cganet.com.
57. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
58. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
59. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
60. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
61. CPA - Composite Panel Association; www.compositepanel.org.
62. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
63. CRRC - Cool Roof Rating Council; www.coolroofs.org.
64. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
65. CSA - CSA Group; www.csagroup.org.
66. CSI - Cast Stone Institute; www.caststone.org.
67. CSI - Construction Specifications Institute (The); www.csiresources.org.
68. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
69. CTA - Consumer Technology Association; www.cta.tech.
70. CTI - Cooling Technology Institute; www.coolingtechnology.org.
71. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
72. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.

73. DHI - Door and Hardware Institute; www.dhi.org.
74. ECIA - Electronic Components Industry Association; www.ecianow.org.
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
78. ESTA - Entertainment Services and Technology Association; www.esta.org.
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; 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.
83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
85. FM Global - FM Global; www.fmglobal.com.
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridaroof.com.
87. FSA - Fluid Sealing Association; www.fluidsealing.com.
88. FSC - Forest Stewardship Council U.S.; www.fscus.org.
89. GA - Gypsum Association; www.gypsum.org.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
94. IAS - International Accreditation Service; www.iasonline.org.
95. ICC - International Code Council; www.iccsafe.org.
96. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
97. ICPA - International Cast Polymer Association (The); www.theicpa.com.
98. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
99. IEC - International Electrotechnical Commission; www.iec.ch.
100. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
101. IES - Illuminating Engineering Society; www.ies.org.
102. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
105. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
106. Intertek - Intertek Group; www.intertek.com.
107. ISA - International Society of Automation (The); www.isa.org.
108. ISFA - International Surface Fabricators Association; www.isfanow.org.
109. ISO - International Organization for Standardization; www.iso.org.
110. ITU - International Telecommunication Union; www.itu.int.
111. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
112. LPI - Lightning Protection Institute; www.lightning.org.
113. MBMA - Metal Building Manufacturers Association; www.mbma.com.
114. MCA - Metal Construction Association; www.metalconstruction.org.
115. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
116. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
117. MHI - Material Handling Industry; www.mhi.org.
118. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
119. MPI - Master Painters Institute; www.paintinfo.com.

120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
121. NAAMM - National Association of Architectural Metal Manufacturers; 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.
124. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
125. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
126. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
127. NBI - New Buildings Institute; www.newbuildings.org.
128. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
129. NCMA - National Concrete Masonry Association; www.ncma.org.
130. NEBB - National Environmental Balancing Bureau; www.nebb.org.
131. NECA - National Electrical Contractors Association; www.necanet.org.
132. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
133. NEMA - National Electrical Manufacturers Association; www.nema.org.
134. NETA - InterNational Electrical Testing Association; www.netaworld.org.
135. NFHS - National Federation of State High School Associations; www.nfhs.org.
136. NFPA - National Fire Protection Association; www.nfpa.org.
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; www.nfrc.org.
139. NGA - National Glass Association; www.glass.org.
140. NHLA - National Hardwood Lumber Association; www.nhla.com.
141. NLGA - National Lumber Grades Authority; www.nlga.org.
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
144. NRCA - National Roofing Contractors Association; www.nrca.net.
145. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
146. NSF - NSF International; www.nsf.org.
147. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
148. NSPE - National Society of Professional Engineers; www.nspe.org.
149. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
151. NWFA - National Wood Flooring Association; www.nwfa.org.
152. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
153. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
154. PDI - Plumbing & Drainage Institute; www.pdionline.org.
155. PLASA - PLASA; www.plasa.org.
156. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
157. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.

166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
167. SIA - Security Industry Association; www.securityindustry.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; 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.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
184. TIA - Telecommunications Industry Association (The); www.tiaonline.org.
185. TMS - The Masonry Society; www.masonrysociety.org.
186. TPI - Truss Plate Institute; www.tpinst.org.
187. TPI - Turfgrass Producers International; www.turfgrasssod.org.
188. TRI - Tile Roofing Industry Alliance; www.tileroofing.org.
189. UL - Underwriters Laboratories Inc.; www.ul.org.
190. UL LLC - UL LLC; www.ul.com.
191. USAV - USA Volleyball; www.usavolleyball.org.
192. USGBC - U.S. Green Building Council; www.usgbc.org.
193. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
194. WA - Wallcoverings Association; www.wallcoverings.org.
195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
196. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
197. WDMA - Window & Door Manufacturers Association; www.wdma.com.
198. WI - Woodwork Institute; www.woodworkinstitute.com.
199. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
200. WWPA - Western Wood Products Association; 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. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
2. ICC - International Code Council; www.iccsafe.org.
3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

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.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.
11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; 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.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; 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/.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from U.S. General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.

6. MILSPEC - Military Specification and Standards; (see DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

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. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
2. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
3. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
4. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
5. 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 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 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.
2. Section 012100 "Allowances" for allowance for metered use of temporary utilities.

1.2 USE CHARGES

A. Installation, removal, and use charges for temporary facilities to 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 construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.

E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. 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 requirements for 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.

F. 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.

G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:

1. Methods used to meet the goals and requirements of Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.
6. Indicate locations of sensitive areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.4 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.

1.5 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. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide bases for supporting posts.

B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.

C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

D. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches (914 by 1524 mm).

2.2 TEMPORARY FACILITIES

A. Field Offices:

1. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. 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. Installation, removal, and use charges for temporary HVAC to be included in the Contract Sum
2. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
3. Heating, Cooling, and Dehumidifying 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.
4. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

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.

C. 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.

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.

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:

1. Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash 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.

1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

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. Installation, removal, and use charges for temporary HVAC to be included in the Contract Sum

2. 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. Electric Power Service:

1. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
   a. Connect temporary service to Owner's existing power source, as directed by Owner.

G. 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.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment based telephone line(s) for each field office.

1. 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. Engineers' offices.
   g. Owner's office.
   h. Principal subcontractors' field and home offices.

I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

J. Project Computer: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area of building lines that is noncombustible in accordance with ASTM E136. 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. 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.

C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

D. Storage and Staging: Provide temporary offsite area for storage and staging needs.

E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. 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.

3. Maintain and touch up signs, so they are legible at all times.

F. Waste Disposal Facilities:

1. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
2. 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."

G. 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.

H. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

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. 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.

D. Tree and Plant Protection:

1. Install temporary fencing to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. Site Enclosure Fence: Before construction operations begin, 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.

F. 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.

G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

H. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.

1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
2. Paint and maintain appearance of walkway for duration of the Work.

I. 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.

J. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
1. Construct dustproof partitions with two layers of 6-mil (0.14-mm) polyethylene sheet on each side. Cover floor with two layers of 6-mil (0.14-mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
3. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
4. Protect air-handling equipment.
5. Provide walk-off mats at each entrance through temporary partition.

K. 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 in accordance with 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.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

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 48 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.
    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 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of This 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 01 10 00 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 01 21 00 "Allowances" for products selected under an allowance.
3. Section 01 23 00 "Alternates" for products selected under an alternate.
4. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
5. Section 01 42 00 "References" for applicable industry standards for products specified.
6. Section 01 77 00 "Closeout Procedures" for submitting warranties.

1.2 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 otherwise indicated.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "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. Evaluating 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,

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 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 "Submittal Procedures."

F. Substitution: Refer to Section 01 25 00 "Substitution Procedures" for definition and limitations on substitutions.

1.3 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 inconspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.

e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 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.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections are to 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 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 Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

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.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

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 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 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."

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.

   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.

   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.

a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

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.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

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.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

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 within seven days of receipt of a request for a comparable product. Architect will notify Contractor of approval or rejection of proposed comparable product within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

1. Architect's Approval of Submittal: Marked with approval notation from Architect's action stamp. See 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 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 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 01 60 00

SECTION 01 73 00 - 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.
3. Installation.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Requirements:

1. Section 01 10 00 "Summary" for coordination and limits on use of Project site.
2. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
3. Section 02 41 19 "Selective Demolition" for demolition and removal of selected portions of the building.

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 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

a. Contractor's superintendent.
b. Trade supervisor responsible for cutting operations.
c. Trade supervisor(s) responsible for patching of each type of substrate.
d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. 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.

a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: Refer to Section 01 40 00 "Quality Requirements."

C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

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. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.
    f. Mechanical systems piping and ducts.
    g. Control systems.
    h. Communication systems.
    i. Fire-detection and -alarm systems.
    j. Conveying systems.
    k. Electrical wiring systems.
    l. Operating systems of special construction.

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.
    g. Noise- and vibration-control elements and systems.

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.

D. 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.

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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.

4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. 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.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. 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."

3.3 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces, unless otherwise indicated on Drawings.

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.

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.

3.4 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 01 10 00 "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. 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 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.

3.5 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 (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with 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.

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 in accordance with 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 015000 "Temporary Facilities and Controls," and 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.

3.6 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

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.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

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.

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 01 73 00

SECTION 01 74 19 - 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. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. 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.

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. Refer to Section 01 35 91 for materials to be salvaged and kept by Owner

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

B. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

C. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

E. 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.

F. 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 according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.

B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

D. Waste Management in Historic Zones or Areas: Transportation equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches (300 mm) or more.

3.2 SALVAGING DEMOLITION WASTE

A. Comply with requirements in Section 02 4119 "Selective Demolition" for salvaging demolition waste.

B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

C. Salvaged Items for Sale and Donation: Not permitted on Project site.

D. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area **designated by Owner**.
5. Protect items from damage during transport and storage.

E. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

F. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

G. Plumbing Fixtures: Separate by type and size.

H. Lighting Fixtures: Separate lamps by type and protect from breakage.

I. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to the Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.

5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

A. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize broken masonry to maximum 3/4-inch (19-mm) size.

2. Clean and stack undamaged, whole masonry units on wood pallets.

B. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

C. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

D. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

E. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.

F. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.

G. Conduit: Reduce conduit to straight lengths and store by material and size.

H. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

D. Paint: Seal containers and store by type.

3.6 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. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.

C. Burning: Do not burn waste materials.

END OF SECTION 01 74 19

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 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. List of incomplete items.
4. Submittal of Project warranties.
5. Final cleaning.

B. Related Requirements:
1. Section 01 32 33 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
2. Section 01 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
3. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.2 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

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1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by 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 Architect's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. 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.

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.
6. Advise Owner of changeover in utility services.

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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
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 will 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.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

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1.8 LIST OF INCOMPLETE ITEMS

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, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, 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 the following format:

a. PDF Electronic File: Architect will return annotated file.

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 by email to Architect.

E. Warranties in Paper Form:

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

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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.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

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 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 weathering of exterior surfaces. Restore reflective surfaces to their original condition.

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g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.
k. 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.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. 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.

q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. 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 01 50 00 "Temporary Facilities and Controls," and Section 017419 "Construction Waste Management and Disposal."

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 01 73 00 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 01 77 00

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SECTION 01 78 39 - 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.
5. Directories.

B. Related Requirements:

1. Section 01 73 00 "Execution" for final property survey.
2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Submit all project record documents as one submittal package.

B. Record Drawings: Comply with the following:

1. Number of Copies: Submit two sets of marked-up record prints.

C. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.

D. Record Product Data: Submit 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 annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 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 archive 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 below first floor.
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.
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. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:

    a. DASCHLAGER HOUSE RENOVATION
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. ARTIFEX AE.
    e. Name of Contractor.

2.2 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. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as paper copy.

2.3 RECORD PRODUCT DATA

A. 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.

B. 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.

2.4 DIRECTORIES

A. Directories: Contractor/Subcontractor directory.

1. Submit one hard copy and one copy on electronic media CD-R or USB storage device in PDF format.

B. Directory: Name, address and telephone number for General Contractor, all major subcontractors, organized by specification section. Provide a separate list in alphabetical order.

2.5 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.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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. Maintenance of Record Documents and Samples: Store record documents and Samples 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.

END OF SECTION 01 78 39

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 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. Refer to Section 01 35 91 Historic Treatment for additional information

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of selective demolition activities with starting and ending dates for each activity.

1.5 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.6 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

   1. Maintain fire-protection facilities in service during selective demolition operations.

F. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Inventory and record the condition of items to be removed and salvaged.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC 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. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

B. 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.

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. 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.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3. 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.
4. Maintain fire watch during and for at least 12 hours after flame-cutting operations.
5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
6. Dispose of demolished items and materials promptly.

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.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. 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, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 CLEANING

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

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. 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 02 41 19

SECTION 02 42 96 - HISTORIC REMOVAL AND DISMANTLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Historic treatment procedures for removal and dismantling work for designated historic spaces, areas, rooms, and surfaces and the following specific work:

   a. Removal and dismantling of indicated portions of building or structure and debris hauling.
   b. Removal and dismantling of indicated site elements and debris hauling.
   c. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 01 35 91 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Dismantle: To disassemble or detach a historic item from a surface, or a non-historic item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

B. Existing to Remain: Existing items that are not to be removed or dismantled, except to the degree indicated for performing required Work.

C. Remove: To take down or detach a non-historic item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

D. Retain: To keep an element or detail secure and intact.

E. Salvage: To protect removed or dismantled items and deliver them to Owner.

1.3 PRECONSTRUCTION MEETINGS

A. Preconstruction Conference(s): Conduct conference(s) at Project site.

1. Review removal and dismantling procedures and protection of historic areas and surfaces.
2. Review list of items indicated to be salvaged.
3. Review methods and procedures related to removal and dismantling work.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by Contractor's removal and dismantling operations.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with notification regulations of authorities having jurisdiction before beginning removal and dismantling work. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as long as practicable.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.

C. Hazardous Materials:

1. It is not expected that hazardous materials will be encountered in the Work.

a. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

1) In the case of asbestos, stop work in the area of potential hazard, shut off fans and other air handlers ventilating the area, and rope off area until the questionable material is identified. Resume work in the area of concern after safe working conditions are verified.

D. Storage or sale of removed or dismantled items on-site is not permitted unless otherwise indicated.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Preparation for Removal and Dismantling: Examine construction to be removed or dismantled to determine best methods to safely and effectively perform removal and dismantling work.

1. Verify that affected utilities are disconnected and capped.

2. Inventory and record the condition of items to be removed and dismantled for reinstallation or salvage. Enter this information on the inventory of salvaged items.

B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

C. Perform surveys as the Work progresses to detect hazards resulting from historic removal and dismantling procedures.

3.2 HISTORIC REMOVAL AND DISMANTLING

A. General: Have removal and dismantling work performed by a qualified historic removal and dismantling specialist.

B. Comply with requirements in Section 013591 "Historic Treatment Procedures" for identifying and storing historic items.

C. Perform work according to the historic treatment program.

D. Water-Mist Sprinkling: Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment according to the historic treatment program to ensure that such water does not create a hazard or adversely affect other building areas or materials.

E. Anchorages:

1. Remove anchorages associated with removed items.
2. Dismantle anchorages associated with dismantled items.
3. In non-historic surfaces, patch holes created by anchorage removal or dismantling according to the requirements for new work.
4. In historic surfaces, patch or repair holes created by anchorage removal or dismantling according to Section that is specific to the historic surface being patched.

END OF SECTION 02 42 96

SECTION 030130 - MAINTENANCE OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of deteriorated concrete and subsequent patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Corrosion-inhibiting treatment.
5. Polymer sealers.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

B. General: Unit prices include the cost of preparing existing construction to receive the work indicated and costs of field quality control required for units of work completed.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: Cured Samples for each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Product test reports.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Concrete removal and patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Polymer sealer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: For repair products, obtain each color, grade, finish, type, and variety of product from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties.

2.2 BONDING AGENTS

A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product that consists of water-insensitive epoxy adhesive, portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.

B. Epoxy Bonding Agent: ASTM C881/C881M, bonding system Type V and free of VOCs.

C. Latex Bonding Agent, Non-Redispersible: ASTM C1059/C1059M, Type II.

2.3 PATCHING MORTAR

A. Patching Mortar Requirements:

1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.
2. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar that matches existing, adjacent, exposed concrete. Blend several aggregates if necessary to achieve suitable matches.
3. Coarse Aggregate for Patching Mortar: ASTM C33/C33M, washed aggregate, Size No. 8, Class 5S. Add to patching-mortar mix only as permitted by patching-mortar manufacturer.

B. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.
1. Compressive Strength: Not less than 5000 psi (34.5 MPa)at 28 days when tested according to ASTM C109/C109M.

C. Rapid-Strengthening, Cementitious Patching Mortar: Packaged, dry mix, ASTM C928/C928M for repair of concrete.
1. Compressive Strength: Not less than 3000 psi (21.0 MPa)within three hours when tested according to ASTM C109/C109M.

D. Polymer-Modified, Cementitious Patching Mortar: Packaged, dry mix for repair of concrete and that contains a non-redispersible latex additive as either a dry powder or a separate liquid that is added during mixing.

1.
2. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C109/C109M.

2.4 JOINT FILLER

A. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.

B. Polyurea Joint Filler: Two-component, semirigid, 100 percent solids, polyurea resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.

C. Color: As selected by Architect from full range of industry colors.

2.5 EPOXY CRACK-INJECTION MATERIALS

A. Epoxy Crack-Injection Adhesive: ASTM C881/C881M, bonding system Type IV, free of VOCs.
1. Capping Adhesive: Product manufactured for use with crack-injection adhesive by same manufacturer.

2.6 POLYMER-SEALER MATERIALS

A. Epoxy Polymer Sealer: Low-viscosity epoxy, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; VOC content 100 g/L or less.
1. Color: As selected by Architect from full range of industry colors.

B. Methacrylate Polymer Sealer: Low-viscosity, high-molecular-weight methacrylate**,** penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; VOC content 100 g/L or less.
1. Color: As selected by Architect from full range of industry colors.

2.7 MISCELLANEOUS MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I, II, or III unless otherwise indicated.

B. Water: Potable.

2.8 MIXES

A. General: Mix products, in clean containers, according to manufacturer's written instructions.

B. Dry-Pack Mortar: Mix required type(s) of patching-mortar dry ingredients with just enough liquid to form damp cohesive mixture that can be squeezed by hand into a ball but is not plastic.

PART 3 - EXECUTION

3.1 CONCRETE MAINTENANCE

A. Have concrete-maintenance work performed only by qualified concrete-maintenance specialist.

B. Comply with manufacturers' written instructions for surface preparation and product application.

3.2 EXAMINATION

A. Notify Architect seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.

B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb unless otherwise indicated.

C. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

3.3 PREPARATION

A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.

B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.

1. Comply with each product manufacturer's written instructions for protections and precautions.
2. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
3. Protect floors and other surfaces along haul routes from damage, wear, and staining.
4. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.
5. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.

C. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.

1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

D. Preparation for Concrete Removal: Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.

1. Verify that affected utilities have been disconnected and capped.
2. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain. Strengthen or add new supports when required during progress of removal work.

E. Reinforcing-Bar Preparation: Remove loose and flaking rust from exposed reinforcing bars by high-pressure water cleaning abrasive blast cleaning needle scaling or wire brushing until only tightly adhered light rust remains.

1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, cut bars and remove and replace as indicated on Drawings.
2. Remove additional concrete as necessary to provide at least 3/4-inch (19-mm) clearance at existing and replacement bars.
3. Splice replacement bars to existing bars according to ACI 318 (ACI 318M) by lapping, welding, or using mechanical couplings.

F. Preparation of Floor Joints for Repair: Saw-cut joints full width to edges and depth of spalls, but not less than 3/4 inch (19 mm)deep. Clean out debris and loose concrete; vacuum or blow clear with compressed air.

3.4 REMOVAL OF CONCRETE

A. Do not overload structural elements with debris.

B. Saw-cut perimeter of areas indicated for removal to a depth of at least 1/2 inch (13 mm). Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.

C. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.

D. Remove additional concrete if necessary to provide a depth of removal of at least 1/2 inch (13 mm)over entire removal area.

E. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least 3/4-inch (19-mm) clearance around bar.

F. Test areas where concrete has been removed by tapping with hammer, and remove additional concrete until unsound and disbonded concrete is completely removed.

G. Provide surfaces with a fractured profile of at least 1/8 inch (3 mm) that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.

H. Thoroughly clean removal areas of loose concrete, dust, and debris.

3.5 APPLICATION OF BONDING AGENT

A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Apply to reinforcing bars. Apply to reinforcing bars in two coats, allowing first coat to dry two to three hours before applying second coat. Allow to dry before placing patching mortar.

B. Epoxy Bonding Agent: Apply to reinforcing bars, leaving no pinholes or other uncoated areas. Apply to reinforcing bars in at least two coats, allowing first coat to dry before applying second coat**.** Place patching mortar while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar.

C. Latex Bonding Agent, Type I: Apply to concrete by brush roller or spray. Allow to dry before placing patching mortar.

D. Latex Bonding Agent, Type II: Mix with portland cement and scrub into concrete surface. Place patching mortar while bonding agent is still wet. If bonding agent dries, recoat before placing patching mortar.

E. Slurry Coat for Cementitious Patching Mortar: Wet substrate thoroughly and then remove standing water. Scrub a slurry of neat patching mortar into substrate, filling pores and voids.

3.6 INSTALLATION OF PATCHING MORTAR

A. Place patching mortar as specified in this article unless otherwise recommended in writing by manufacturer or where dry-pack mortar is indicated.

1. Provide forms where necessary to confine patch to required shape.
2. Wet substrate and forms thoroughly and then remove standing water.

B. Pretreatment: Apply specified bonding agent and slurry coat.

C. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.

D. Vertical Patching: Place material in lifts of not more than thickness recommended by manufacturer. Do not feather edge.

E. Overhead Patching: Place material in lifts of not more than thickness recommended by manufacturer. Do not feather edge.

F. Consolidation: After each lift is placed, consolidate material and screed surface.

G. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.

H. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a surface matching adjacent concrete.

I. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.7 INSTALLATION OF DRY-PACK-MORTAR

A. Use dry-pack mortar for deep cavities and where indicated. Place as specified in this article unless otherwise recommended in writing by manufacturer.

1. Provide forms where necessary to confine patch to required shape.
2. Wet substrate and forms thoroughly and then remove standing water.

B. Pretreatment: Apply specified **bonding agent and slurry coat**.

C. Place dry-pack mortar into cavity by hand, and compact tightly into place. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.

D. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete.

E. Wet-cure patch for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.8 FLOOR-JOINT REPAIR

A. Cut out deteriorated concrete and reconstruct sides of joint with patching mortar as indicated on Drawings. Install joint filler in nonmoving floor joints where indicated and as specified in this article.

B. Depth: Install joint filler to a depth of at least 3/4 inch (19 mm). Use fine silica sand no more than 1/4 inch (6 mm) deep to close base of joint. Do not use sealant backer rods or compressible fillers below joint filler.

C. Top Surface: Install joint filler so that when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.

3.9 EPOXY CRACK INJECTION

A. Clean cracks with oil-free compressed air or low-pressure water to remove loose particles.

B. Clean areas to receive capping adhesive of oil, dirt, and other substances that would interfere with bond.

C. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive.

D. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least 1/4 inch (6 mm) thick by 1 inch (25 mm) wider than crack.

E. Inject cracks wider than 0.003 inch (0.075 mm) to a depth of 8 inches (200 mm).

F. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.

G. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

3.10 APPLICATION OF POLYMER SEALER

A. Apply polymer sealer by brush, roller, or airless spray at manufacturer's recommended application rate.

B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections as necessary.

B. Product will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 030130

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Shoring, bracing, and anchoring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following:
1. Waterstops.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer who is licensed in the State of Maine, and who is responsible for their preparation, detailing fabrication, assembly, and support of forms.
1. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301 (ACI 301M).

a. Location of construction joints is subject to approval of the Architect.

2. Indicate location of waterstops.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Minutes of preinstallation conference.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 (ACI 301M), 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.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

    a. For architectural concrete specified as "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

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 MDO (medium-density overlay); mill-release agent treated and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 WATERSTOPS

A. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572 for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
1. Profile: Ribbed with center bulb or As indicated.
2. Dimensions: 6 inches by 3/8 inch thick (150 mm by 10 mm thick); nontapered.

B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

2.4 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) 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 (0.85 mm) 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 (19 by 19 mm), 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.

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.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301 (ACI 301M).

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M) 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 (25 mm).
2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch (6 mm).
3.

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.

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. Chamferexterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches (305 mm).

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. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

    a. 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.

    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.
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 (305 mm) 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.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a **special inspector and qualified testing and inspecting agency** to perform field tests and inspections as necessary and prepare test reports.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.
4.

B. 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, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. 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. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

2. Mechanical splice couplers.

B. Minutes of preinstallation conference.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), Grade 40 for stirrups and ties, deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

A. 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, or CRSI Class 2 stainless steel bar supports.

B. Mechanical Splice Couplers: ACI 318 (ACI 318M) Type 1 or Type 2, same material of reinforcing bar being spliced; compression-only type tension-compression type dowel-bar type or mechanical-lap type.

C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.

1. Finish: Plain or Galvanized .

D. Stainless Steel Tie Wire: ASTM A1022/A1022M, not less than 0.0508 inch (1.2908 mm) in diameter.

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 (25 mm), 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 (ACI 318M).

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 40 bar diameters at splices, or 24 inches (610 mm), whichever is greater.
2. Stagger splices in accordance with ACI 318 (ACI 318M).
3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

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 (305 mm).

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches (50 mm) for plain wire and 8 inches (200 mm) for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

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.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117 (ACI 117M).

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections as necessary and prepare test reports.

B. Inspections:

1. Steel-reinforcement placement.
2. Steel-reinforcement mechanical splice couplers.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

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. 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. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Aggregates.
6. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at

time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

7. Vapor retarders.
8. Liquid floor treatments.
9. Curing materials.
10. Joint fillers.
11. Bonding agents.
12. Adhesives
13. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Intended placement method.
11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. 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.

2. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" 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. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Curing compounds.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Semirigid joint filler.
12. Joint-filler strips.

B. 13. Repair materials.Material Test Reports: For the following, from a qualified testing agency:
1. Aggregates.

C. Research Reports: For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

D. Preconstruction Test Reports: For each mix design.

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. 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 certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

C. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. 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 concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing-Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

B. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M).

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete,"

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

2.2 CONCRETE MATERIALS

A. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II**gray**
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3Scoarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Air-Entraining Admixture: ASTM C260/C260M.

D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type F.
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.

E. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. 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 deg F (10 deg C) and 85 deg F (29 deg C): Any color.
c. Ambient Temperature Above 85 deg F (29 deg C): White.

C. Curing Paper: 8-feet- (2438-mm-) wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.

D. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products:
a. Dayton Superior Corporation; Sure Film.
b. Euclid Chemical Company (The); Eucobar.
c. Sika Corporation, Inc.; SikaFilm.
d. Symons Corporation, a Dayton Superior Company; Finishing Aid

E. Water: Potable or complying with ASTM C1602/C1602M.

F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

1.

2.6 CONCRETE MIXTURES, GENERAL

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 (ACI 301M).

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 cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
4. 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.

2.7 CONCRETE MIXTURES

A. Normal-weight concrete used for footings, grade beams, and tie beams.

1. Exposure Class: ACI 318 (ACI 318M) F3.
2. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
3. Maximum w/cm: 0.45.
4. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm) before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Air Content:
   a. 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size.
6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

B. Normal-weight concrete used for foundation walls.

1. Exposure Class: ACI 318 (ACI 318M) F3.
2. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
3. Maximum w/cm: 0.45.
4. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm) before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Air Content:
   a. 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size.
6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

C. Normal-weight concrete used for interior slabs-on-ground.
1. Minimum Compressive Strength: 4500 psi (31 MPa at 28 days.
2. Maximum w/cm: 0.45.
3. Minimum Cementitious Materials Content540 lb/cu. yd. (320 kg/cu. m).
4. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm)before adding high-range water-reducing admixture or plasticizing admixture.
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. Normal-weight concrete used for interior suspended slabs.

1. Exposure Class: ACI 318 (ACI 318M) S2.
2. Minimum Compressive Strength: 4500 psi (31 MPa at 28 days.
3. Maximum w/cm: 0.45.
4. Minimum Cementitious Materials Content: 540 lb/cu. yd. (320 kg/cu. m).
5. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm) before adding high-range water-reducing admixture or plasticizing admixture Project site.

6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Normal-weight concrete used for building frame members.
1. Minimum Compressive Strength: 4500 psi (31 MPa) at 28 days.
2. Maximum w/cm: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm) before adding high-range water-reducing admixture or plasticizing admixture at Project site.
4. Air Content:
   a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size.

5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

F. Normal-weight concrete used for building walls.
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum w/cm: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm) before adding high-range water-reducing admixture or plasticizing admixture at Project site.
4. Air Content:
   a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size.

5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

G. Normal-weight concrete used for interior metal pan stairs and landings:
1. Minimum Compressive Strength: 3000 psi (20.7 MPa**)** at 28 days.
2. Maximum w/cm: 0.53.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m).
4. Maximum Size Aggregate: 1/2 inch (13 mm).
5. Slump Limit: 3 inches (75 mm), plus 1 inch (25 mm) or minus 2 inches (50 mm).
6. Air Content: **0** percent, plus or minus 0.5 percent at point of delivery.

7. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
8. Retarding Admixture: Not allowed.
9. Accelerating Admixture: Not allowed.

H. Normal-weight concrete used for exterior retaining walls.

1. Exposure Class: ACI 318 (ACI 318M) S3.
2. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
3. Maximum w/cm: 0.45.
4. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm) before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Air Content:
   a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size.
6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94Mand furnish batch ticket information.

PART 3 - EXECUTION

3.1 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 specific directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303. Use templates to locate anchors as required.
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.

3.2 INSTALLATION OF VAPOR RETARDER

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 (150 mm), sealing vapor retarder to concrete.
4. Lap joints 6 inches (150 mm) 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 (150 mm) on all sides, and sealing to vapor retarder.

3.3 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 (38 mm) 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.

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. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks. Form joints with Soff-Cut early entry dry-cut control joint saw cutting. Install cuts at each control joint location as soon as concrete will support weight of saw and operator without disturbing final finish. Provide adequate equipment to complete cutting operations within 2 hours after final pass of trowel. Use Soff-Cut blades and skid plates, using a new skid plate with each new blade. Remove debris in path of cut and under skid plate before cutting. Install Soff-Cut joint protector at saw-cut intersection

prior to cross-cut. Remove dry powder saw cut concrete spoils immediately without disturbing finish.

3. Joint Width: 1/8-inch for slabs to receive floor coverings. 1/4-inch for joints to be left exposed and filled with joint sealant.
4. Contraction joints shall be placed in accordance with approved Shop Drawings. The panel shall be as nearly square as possible. If panel cannot be square, do not exceed panel length to panel width ratio of 1 to 1-1/2. Conform to bay spacing wherever possible (at column centerlines, half bays, third bays, one quarter bays, or equal division to meet the specified spacing requirements).
5. Make initial saw cut at mid-length of slab and proceed by saw-cutting at mid-length of each subsequent panel until all joints have been cut.
6. Joints are not permitted in slabs of coolers or freezers.
7. Avoid traffic across saw cut until sufficient strength is gained to protect joint edges.
8. Saw cut slabs on grade in accordance with spacing indicated. Where not indicated, saw cut in accordance with the following maximum spacing:
   4 inches thick slab: 8 feet.
   5 to 6 inches thick: 10 feet.
   6 1/4 to 7 inches thick: 12 feet.

D. 7 1/4 to 8 inches thick: 14 feet.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 (13 mm) or more than 1 inch (25 mm) 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.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.4 CONCRETE PLACEMENT

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. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

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.

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 (ACI 301M).

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 (150 mm) 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.

3.5 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 (38 mm) wide or 1/2 inch (13 mm) deep.
b. Remove projections larger than 1 inch (25 mm).
c. Tie holes do not require patching.
d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
e. Apply to concrete surfaces not exposed to public view.

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 (19 mm) wide or 1/2 inch (13 mm) deep.
b. Remove projections larger than 1/4 inch (6 mm).
c. Patch tie holes.
d. Surface Tolerance: ACI 117 (ACI 117M) Class B.
e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.6 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

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 restraighten 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.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3 mm)and also no more than 1/16 inch (1.6 mm) in 2 feet (610 mm).

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 fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.7 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 blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-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 (100 mm) high unless otherwise indicated on Drawings, and extend base not less than 6 inches (150 mm) 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 (27.6 MPa)at 28 days.
4. For supported equipment, install anchor bolts that extend through concrete base and anchor into structural concrete substrate.
5. 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.

3.8 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.

3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) 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.

C. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:

1. Begin curing immediately 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 (300 mm).
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 (300 mm), 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) Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project

b. .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 unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

c. 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.
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.

3.9 TOLERANCES

A. Conform to ACI 117 (ACI 117M).

3.10 FIELD QUALITY CONTROL

A. 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 container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with 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 shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

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.
13) Information on storage and curing of samples before testing, 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.

B. Batch Tickets: For each load delivered, submit copies of batch delivery tickets to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:
1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.

D. Verification of concrete strength before removal of shores and forms from beams and slabs.Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall 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. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

   a. When frequency of testing provides 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.

2. Slump: ASTM C143/C143M:

   a. 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.
   b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;.

   a. 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:

   a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31/C31M:

   a. Cast and laboratory cure two sets of two 6-inch (150 mm) by 12-inch (300 mm) or 4-inch (100 mm) by 8-inch (200 mm) cylinder specimens for each composite sample.
   b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one set of two laboratory-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.

7. 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.
8. Strength of each concrete mixture will be satisfactory if every 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 (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).
9. 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.
10. 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.
    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 (ACI 301M), Section 1.6.6.3.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. If directed by the Owner, measure floor and slab flatness and levelness in accordance with ASTM E1155 (ASTM E1155M) within 48hours of completion of floor finishing and promptly report test results to Architect.

3.11 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.

END OF SECTION 033000

SECTION 04 03 10 - HISTORIC MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of cleaning historic clay brick masonry surfaces.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

B. Medium-Pressure Spray:

1. Pressure: 400 to 800 (2750 to 5510) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to cleaning historic masonry.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry cleaning specialist. Experience cleaning new masonry work is insufficient experience for historic treatment work.

B. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m) for each type of masonry and surface condition.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.

1. Basis of design:
   a. Sure Klean Ferrous Stain Remover, by Prosoco.

2.2 CHEMICAL-CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Brick and Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 CLEANING MASONRY, GENERAL

A. Have cleaning work performed only by qualified historic treatment specialist.

B. Proceed with cleaning in an orderly manner; work from bottom to top of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

C. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.

D. Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.

1. Keep wall wet below area being cleaned to prevent streaking from runoff.

E. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush application. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

F. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

3.2 PRELIMINARY CLEANING

A. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, caulking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.

3.3 CLEANING BRICKWORK

A. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Rinse with cold water applied by low- or medium-pressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.4 CLEANING UNPOLISHED STONEWORK

A. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Rinse with cold water applied by low- or medium-pressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection and provide on-site

assistance when requested by Architect. Have chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than once to observe progress and quality of the Work.

END OF SECTION 04 03 10

SECTION 04 03 23 - HISTORIC BRICK UNIT MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repointing brick masonry joints.

B. Related Requirements:

1. Section 01 35 91 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 01 22 00 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.
2. Review methods and procedures related to repointing historic brick masonry.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry repointing specialist. Experience in pointing or repointing only new or non-historic masonry is insufficient experience for masonry historic treatment work.

B. Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white **or gray or both** where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

E. Water: ASTM C270, potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which

is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 4 parts lime, and 12 parts sand. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

3.2 MASONRY REPOINTING, GENERAL

A. Have repointing work performed only by qualified historic treatment specialist.

3.3 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of 2-1/2 times joint width. Do not remove unsound mortar more than 2 (50) inches (mm) deep; consult Architect for direction.
2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of bricks or widen joints. Replace or patch damaged bricks as directed by Architect.

a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 (9) inch(es) (mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 (9) inch(es) (mm). Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing brick have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

    a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
    b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.4 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 04 03 23

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shear stud connectors, shop welded.
3. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking".

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings.

B. Architecturally Exposed Structural Steel: Structural steel designated as architecturally exposed structural steel in the Contract Documents.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Shop primer.
7. Galvanized-steel primer.
8. Galvanized repair paint.
9. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

C. 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, registered in the State of Maine, responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural-steel materials, including chemical and physical properties:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Non-shrink grout.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that meets the standards of the AISC Quality Certification Program and is qualified to be an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and meets the requirements as an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

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 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Option 2: Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.

    a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
    b. Use Allowable Stress Design; data are given at service-load level.

2. Option 3 and 3A: Design connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer. Member reinforcement at connections is indicated on Drawings.

    a. Use Allowable Stress Design; data are given at service-load level.

3. Option 3 and 3B: Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.

    a. Use Allowable Stress Design; data are given at service-load level.

C. Moment Connections: Type PR, partially restrained.

D. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles: ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490 (Grade A490M), Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.
2. .

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain unless otherwise noted.

E. 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.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36.

1. Configuration: Hooked.
2. Finish: Plain or as indicated, Hot-dip zinc coating, ASTM A153/A153M, Class C.

B. Headed Anchor Rods: ASTM F1554, Grade 36, straight.

1. Finish: Plain, or as indicated, Hot-dip zinc coating, ASTM A153/A153M, Class C.

C. Threaded Rods: ASTM A36/A36M.

1. Finish: Plain, or as indicated, Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 PRIMER

A. Steel Primer:
1. 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, MPI#19, or SSPC-Paint 20.

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.

B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.

1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.
2. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.

C.

D. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

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: Snug tightened, unless otherwise indicated.

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.

2.9 GALVANIZING

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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 and shelf angles attached to structural-steel frame and located in exterior walls.

2.10 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.

3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

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 3.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.

D. 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 (0.038 mm). 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 inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections, if required by special 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, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E165/E165M.
b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E164.
d. Radiographic Inspection: ASTM E94/E94M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

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.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

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, Bearing Plates 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. Snug-tighten 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.

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: Snug tightened.

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.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector as required to perform the following special 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. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

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 testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.
2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3) Ultrasonic Inspection: ASTM E164.
4) Radiographic Inspection: ASTM E94/E94M.

3.6 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 051200

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Interior non-load-bearing wall framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Interior non-load-bearing wall framing.
5. Vertical deflection clips.
6. Single deflection track.
7. Double deflection track.
8. Drift clips.
9. Post-installed anchors.
10. Power-actuated anchors.

B. 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.

C. Delegated-Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product test reports.

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

C. Research Reports:

1. For non-standard cold-formed framing, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

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.

C. 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."

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. ClarkDietrich Building Systems, Inc.
2. MarinoWARE.
3. CRACO Mfg., Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified, licensed in the State of Maine, professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S240.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Framing Members, General: Comply with AISI S240 for conditions indicated.

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST33H (ST230H), minimum, and **as** required by structural performance.
2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZM150), or GF30 (ZGF90).

C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 33 (230), minimum, and **as** required by structural performance.
2. Coating: G60 (Z180).

2.4 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: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and matching minimum base-metal thickness of steel studs.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm).

2.5 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: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

C. Vertical Deflection Clips, Exterior: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

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.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

2.6 INTERIOR 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: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

C. Vertical Deflection Clips, Interior: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

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.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

2.7 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.

2.8 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, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

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 AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

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.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: MIL-P-21035B or 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 (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. 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.

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

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 cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. 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.

F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

G. 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.

H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.3 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: 32 inches (813 mm), maximum, or as shown on Shop Drawings.

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch (3 mm) between the end of wall-framing member and the web of track.

1. Fasten both flanges of studs to top and bottom tracks.
2. Space studs as follows:

    a. Stud Spacing: 16 inches (406 mm),maximum, typically, or as indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically 48 inches (1220 mm), typically, or as indicated on Shop Drawings. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
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.

J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 INSTALLATION OF EXTERIOR NON-LOAD-BEARING 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: 16 inches (406 mm) maximum spacing, or as indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

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 bypassing studs 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 (1220 mm) 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.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) 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 96-inch (2440-mm) centers unless otherwise 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 OF INTERIOR NON-LOAD-BEARING 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: 16 inches (406 mm) maximum spacing

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

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 studs 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 (1220 mm) 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.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) 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 96-inch (2440-mm) centers unless otherwise 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.

3.6 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 (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative errors are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.7 REPAIRS

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.

B. 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.

3.8 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. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Shelf angles.
3. Metal ladders.
4. Metal floor plate.
5. Elevator pit sump covers.
6. Structural-steel door frames.
7. Miscellaneous steel trim.
8. Metal bollards.
9. Pipe and downspout guards.
10. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
1. Fasteners.
2. Shop primers.
3. Shrinkage-resisting grout.
4. Slotted channel framing.
5. Manufactured metal ladders.
6. Metal bollards.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated Design Submittals: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

B. Structural Performance of Aluminum Ladders: Ladders are to withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

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. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304 or Type 316L.

D. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

E. Rolled-Stainless Steel Floor Plate: ASTM A793.

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: As indicated.
2. Material: Galvanized steel, ASTM A653/A653M, structural steel**,** Grade 33 (Grade 230), with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness, unless otherwise noted.
3. Material: Cold-rolled steel, ASTM A1008/A1008M, structural steel, Grade 33 (Grade 230); 0.0966-inch (2.5-mm) minimum thickness, unless otherwise noted; coated with rust-inhibitive, baked-on, acrylic enamel or hot-dip galvanized after fabrication.

I. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

J. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

K. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

L. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

M. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

N. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or UNS No. C84400 (leaded semired brass).

O. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 or Type 316 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 aluminum stainless steel or nickel silver.
2. Provide bronze fasteners for fastening bronze.

B. 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.

C. Post-Installed Anchors: Screw-type 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: Group 2 (A4)] stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).

D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." 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.

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 (20 MPa).

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 (1 mm) 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. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c.

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.

C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches (600 mm) o.c., unless otherwise noted.

D. Fabricate steel columns for supporting wood frame construction from steel pipe or hollow structural steel, with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to column with fillet welds all around. Make welds the same size as column wall thickness unless otherwise indicated.

2.7 PREFABRICATED BUILDING COLUMNS

2.8 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize and prime shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with zinc-rich primer.

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.9 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 (406 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
3. Rungs: 3/4-inch- (19-mm-) diameter or 3/4-inch- (19-mm-) square, 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.
6. Galvanize and prime exterior ladders, including brackets.
7. Prime exterior ladders, including brackets and fasteners, with zinc-rich primer.

C. Aluminum Ladders:

1. Space siderails 16 inches (406 mm) apart unless otherwise indicated.
2. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches (64 mm) deep, 3/4 inch (19 mm) wide, and 1/8 inch (3.2 mm) thick.
3. Rungs: Extruded-aluminum tubes, not less than 3/4 inch (19 mm) deep and not less than 1/8 inch (3.2 mm) thick, with ribbed tread surfaces.

2.10 METAL FLOOR PLATE

A. Fabricate from rolled-steel floor plate of thickness indicated below:

1. Thickness: As indicated.

B. Provide steel angle supports as indicated.

C. Provide flush steel bar drop handles for lifting removable sections, one at each end of each section.

2.11 ELEVATOR PIT SUMP COVERS

A. Fabricate from 3/16-inch (4.8-mm) rolled-steel floor plate with four 1-inch- (25-mm-) diameter holes for water drainage and for lifting.

2.12 STRUCTURAL-STEEL DOOR FRAMES

A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch (16-by-38-mm) steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Reinforce frames and drill and tap as necessary to accept finish hardware.

1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.

B. Galvanize exterior steel frames.

C. Prime exterior steel frames with zinc-rich primer.

2.13 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.14 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe or steel shapes, as indicated.

B. Fabricate sleeves for bollard anchorage from steel or stainless steel pipe or tubing with 1/4-inch-(6.4-mm-) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard, unless otherwise noted.

C. Prime steel bollards with zinc-rich primer.

2.15 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.

2.16 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. Galvanize loose steel lintels located in exterior walls.

2.17 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.

2.18 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

2.19 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, for galvanized items to be painted.

B. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated. Do not shop prime galvanized items not to be painted.

1. Shop prime with primers specified in Section 099113 "Exterior Painting" primers specified in Section 099123 "Interior Painting"unless zinc-rich primer is indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
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."

D. 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.

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.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for ceiling hung toilet partitions operable partitions overhead doors and overhead grilles securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction with anchor bolts or through bolts.

D. Support steel girders on solid grouted masonry, concrete, or steel columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of columns.

3.3 INSTALLATION OF SHELF ANGLES

A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

3.4 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.

3.5 INSTALLATION OF METAL FLOOR PLATE

A. Install metal floor plates flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

3.6 INSTALLATION OF ELEVATOR PIT SUMP COVERS

A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

3.7 INSTALLATION OF STRUCTURAL-STEEL DOOR FRAMES

A. Fasten structural steel door frames to the floor slab by means of angle clips and expansion bolts. Anchor door jambs to adjacent construction in accordance with shop drawing details.

3.8 INSTALLATION OF MISCELLANEOUS STEEL TRIM

A. Anchor to concrete construction to comply with manufacturer's written instructions.

3.9 INSTALLATION OF METAL BOLLARDS

A. Anchor bollards in place with concrete footings as indicated in plans. Center and align bollards in holes 3 inches (75 mm) minimum above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.10 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.

3.11 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.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum railings.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Handrail brackets.
3. Paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) 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.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.3 ALUMINUM HRAILINGS

A. Basis of Design:
   1. Julius Blum & Co, Inc.; Aluminum pipe rail

B. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

C. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.

D. Die and Hand Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.

E. Castings: ASTM B26/B26M, Alloy A356.0-T6.

2.4 FASTENERS

A. Fastener Materials:

   1. Aluminum Railing Components: Type 304 stainless steel fasteners.

B. Post-Installed 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 AC193.

   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.

2.5 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast aluminum, center of handrail 3-1/8 inches (79.4 mm) from wall.
   1. Basis of Design: Julius Blum & Co, Inc.; Wall Bracket #389

B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.

   1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

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. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

B. Form work true to line and level with accurate angles and surfaces.

C. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

D. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

E. Form changes in direction as follows:

1. By inserting prefabricated elbow fittings.

F. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

G. 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 (6 mm) or less.

H. 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 plaster or 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.

I. Provide inserts and other anchorage devices for connecting railings to masonry work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
2. Coordinate anchorage devices with supporting structure.

2.7 ALUMINUM FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. 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.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41.

PART 3 - EXECUTION

3.1 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. 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 (6 mm in 3.5 m).

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 ATTACHING RAILINGS

A. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.

B. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

3.3 CLEANING

A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

END OF SECTION 05 52 13

SECTION 06 03 12 - HISTORIC WOOD REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of wood in the form of repairing wood features as follows:

1. Repairing wood trim.
2. Replacing wood trim.

B. Related Requirements:

1. Section 01 35 91 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 08 03 52 "Historic Treatment of Wood Windows" for historic wood window repairs, including related trim.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts indicating materials, profiles, joinery, reinforcing, method of splicing or attaching wood members to other surfaces, accessory items, and finishes.

1.3 QUALITY ASSURANCE

A. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation, Project-site inspection, and on-site assistance.

PART 2 - PRODUCTS

2.1 HISTORIC WOOD REPAIR, GENERAL

A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWMAC/WI's "North American Architectural Woodwork Standards" for construction, finishes, grade rules, and other requirements unless otherwise indicated.

1. Exception: Industry practices cited in Section 12, Paragraph 6, "Industry Practices," under Article 12.1, "Basic Considerations," of AWMAC/WI's "North American Architectural Woodwork Standards" do not apply to the Work of this Section.

2.2 REPLICATED WOOD ITEMS

A. Replicated Wood Trim.

1. Wood Species: Match species of existing wood.
2. Wood Member and Trim Profiles: Match profiles and detail of existing.

2.3 WOOD-REPLACEMENT MATERIALS

A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.

1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

B. Exterior Trim: Match existing species.

C. Interior Trim: Match existing species.

2.4 WOOD-REPAIR MATERIALS

A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

B. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound must be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound must be capable of filling deep holes and spreading to featheredge.

2.5 HARDWARE

A. Hardware, General: Provide hardware required for each type of replicated or repaired wood, including, but not limited to, hinges, pulls, latches, fasteners, and accessories indicated or required for proper operation. Hardware must smoothly operate, tightly close, and secure units appropriately for frequency of use, unit weight, and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.

C. Material and Design:

1. Material: Solid bronze of alloy indicated unless otherwise indicated.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.6 MISCELLANEOUS MATERIALS

A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage caused by fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.

B. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.
2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

C. Adhesives: Wood adhesives with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair and exposure condition.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.
3. Use concealed fasteners for attaching items to other work unless exposed fasteners are the existing fastening method.
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

2.7 WOOD FINISHES

A. Unfinished Replacement Units: Provide exposed exterior and interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean wood of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with

mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC WOOD REPAIR, GENERAL

A. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove coatings and apply borate preservative treatment before repair. Remove coatings in accordance with Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
3. Repair items in place where possible.
4. Install temporary protective measures to protect wood-treatment work that is indicated to be completed later.
5. Refinish historic wood in accordance with Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the Work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods, such as sanding, wire brushing, or power tools, except as approved by Architect.

C. Repair Wood: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair wood by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Where indicated, repair wood by limited replacement matching existing material.

D. Replace Wood: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

E. Identify removed items with numbering system corresponding to item locations, to ensure reinstallation in same location.

3.3 WOOD PATCH-TYPE REPAIR

A. General: Patch wood that exhibits depressions, holes, or similar voids, and that has limited amounts of rotted or decayed wood.

1. Treat wood with wood consolidant prior to application of patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and refuses to absorb more. Allow treatment to harden before filling void with patching compound.

2. Remove rotted or decayed wood down to sound wood.

B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.

C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD-REPLACEMENT REPAIR

A. General: Replace parts of or entire wood items at locations where damage is too extensive to patch.

1. Remove broken, rotted, and decayed wood down to sound wood.
2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Repair remaining depressions, holes, or similar voids with patch-type repairs.

D. Reinstall items removed for repair into original locations.

END OF SECTION 06 03 12

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Shear wall panels.
4. Rooftop equipment bases and support curbs.
5. Wood blocking, cants, and nailers.
6. Wood furring and grounds.
7. Wood sleepers.
8. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of process and factory-fabricated product.
2. For preservative-treated wood products.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. 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.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Engineered wood products.
3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: 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.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber 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. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less; 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.
3. Timber: 19 percent.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 PRESERVATIVE TREATMENT

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that 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 cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions by Grade: Construction or No. 2 grade.
1. Species:

a. Hem-fir (north); NLGA.
b. Mixed southern pine; SPIB.
c. Spruce-pine-fir; NLGA.
d. Hem-fir; WCLIB, or WWPA.
e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
f. Northern species; NLGA.
g. Eastern softwoods; NeLMA.

B. Framing Other Than Non-Load-Bearing Partitions by Grade: **No.1 or No. 2** grade.

1. Application: Framing other than interior partitions not indicated as load bearing.
2. Species:

a. Hem-fir (north); NLGA.
b. Southern pine; SPIB.
c. Douglas fir-larch; WCLIB or WWPA.
d. Southern pine or mixed southern pine; SPIB.
e. Spruce-pine-fir; NLGA.

2.4 ENGINEERED WOOD PRODUCTS

A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
1. Extreme Fiber Stress in Bending, Edgewise: 2600 psi (17.9 MPa) for 12-inch nominal-depth members.

2. Modulus of Elasticity, Edgewise: 2,000,000 psi (13 700 MPa).
3. Horizontal Shear Parallel to Grain: 285 psi.
4. Compression Perpendicular to Grain: 750 psi
5. Compression Parallel to Grain: 2510 psi
6. Tension Parallel to Grain: 1895 psi.

B. Laminated-Veneer Lumber, Pressure-Treated: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
1. Extreme Fiber Stress in Bending, Edgewise: 2250 psi for 12-inch nominal- depth members.
2. Modulus of Elasticity, Edgewise: 1,600,000 psi
3. Horizontal Shear Parallel to Grain: 230 psi.
4. Compression Perpendicular to Grain: 750 psi
5. Compression Parallel to Grain: 2350 psi
6. Tension Parallel to Grain: 1500 psi.

C. Parallel-Strand Lumber: Structural composite lumber made from wood fibers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
1. Extreme Fiber Stress in Bending, Edgewise: 2400 psi for 12-inch nominal- depth members.
2. Modulus of Elasticity, Edgewise: 1,800,000 psi
3. Horizontal Shear Parallel to Grain: 190 psi.
4. Compression Perpendicular to Grain: 425 psi
5. Compression Parallel to Grain: 2500 psi
6. Tension Parallel to Grain: 1995 psi.

D. Parallel-Strand Lumber, Pressure-Treated: Structural composite lumber made from wood fibers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559. Allowable Design Stresses of PSL prior to Treatment:
1. Extreme Fiber Stress in Bending, Edgewise: 2900 psi for 12-inch nominal- depth members.
2. Modulus of Elasticity, Edgewise: 2,000,000 psi
3. Horizontal Shear Parallel to Grain: 290 psi.
4. Compression Perpendicular to Grain: 625 psi
5. Compression Parallel to Grain: 2900 psi
6. Tension Parallel to Grain: 2300 psi.

2.5 MISCELLANEOUS LUMBER

A. 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. Cants.
5. Furring.

6. Grounds.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.7 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Where rough 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 A153/A153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

H. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.

2.8 METAL FRAMING ANCHORS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough 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, or of Type 304 stainless steel.

B. Allowable design loads, as published by manufacturer, are to meet or exceed those of basis-of-design products. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Products by Simpson Strong-Tie Co., Inc.

D. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 (Z180) coating designation.

   1. Use for interior locations unless otherwise indicated.

E. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; 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 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

   1. Use for wood-preservative-treated lumber and where indicated.

2.9 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:
   1. Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. 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 (0.6 mm).

C. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

H. Securely attach rough 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 (IBC).
2. ICC-ES evaluation report for fastener.

3.2 PROTECTION

END OF SECTION 06 10 00

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Subflooring.
5. Underlayment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

A. Plywood: DOC PS 1.

B. Oriented Strand Board: DOC PS 2.

2.2 WALL SHEATHING

A. Plywood Sheathing, Walls: DOC PS 1 Exterior, Structural I sheathing.

B. Oriented-Strand-Board Sheathing, Walls: DOC PS 2, Exposure 1, Structural I sheathing.
1. .

2.3 ROOF SHEATHING

A. Plywood Sheathing, Roofs: DOC PS 1 Exterior, Structural I sheathing.

2.4 PARAPET SHEATHING

A. Plywood Sheathing, Parapets: DOC PS 1, Exterior, Structural I sheathing.

B. Oriented-Strand-Board Sheathing, Parapets: DOC PS 2, Exposure 1, Structural I sheathing.

2.5 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subflooring: DOC PS 1 Exposure 1, Structural I single-floor panels or sheathing.

B. Underlayment: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch (6.4 mm) over smooth subfloors and not less than 3/8 inch (9.5 mm) over board or uneven subfloors.

1. Plywood Underlayment for Resilient Flooring: DOC PS 1, [Exposure 1 Underlayment with fully sanded face.
2. Plywood Underlayment for Carpet: DOC PS 1, Exposure 1, Underlayment.

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. For roof parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

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.

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. Coordinate wall parapet 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.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. 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 WOOD STRUCTURAL PANEL INSTALLATION

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 below:

1. Subflooring:

    a. Nail or screw to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch (3 mm) apart at edges and ends.

2. Wall and Roof Sheathing:

    a. Nail or screw to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch (3 mm) apart at edges and ends.

3. Underlayment:

    a. Nail to subflooring.
    b. Space panels 1/32 inch (0.8 mm) apart at edges and ends.
    c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

END OF SECTION 06 16 00

SECTION 06 16 13 – INSULATING SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. insulating wall sheathing with integral water-resistive barrier and air barrier.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Evaluation Reports: From ICC-ES, for wood sheathing and seam tape.

1.3 CLOSEOUT SUBMITTALS

A. Warranty: Executed copy of manufacturer special warranties.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide wood products from manufacturer certified by SFI, FSC, or comparable sustainable forestry program acceptable to Architect.

B. Provide wall sheathing products meeting requirements for water-resistive barrier in accordance with ICC-ES AC310.

C. Provide wall sheathing products meeting requirements of ICC-ES AC269.

1.5 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which sheathing manufacturer agrees to repair or replace sheathing products that demonstrate deterioration or failure under normal use due to manufacturing defects within warranty period specified, when installed according to manufacturer's instructions.

1. Warranty Period for Sheathing Products: 30 years following date of Substantial Completion.
2. Warranty Conditions: Special warranties exclude deterioration or failure due to structural movement resulting in stresses on sheathing products exceeding manufacturer's written specifications, or due to air or moisture infiltration resulting from cladding failure or mechanical damage.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

A. Huber Engineered Woods LLC

B. As approved by Architect

2.1 PERFORMANCE REQUIREMENTS

A. Air-Barrier Assembly Air Leakage: Less than 0.04 cfm/sq. ft. at 1.57 lbf/sq. ft. (0.2 L/s x sq. m at 75 Pa), per ASTM E2375.

B. Water-Vapor Permeance, Facer: Minimum 12 perms (689 ng/Pa x s x sq. m), ASTM E96/E96M.

C. Weather Exposure: Manufacturer warranty applies for maximum allowable exposure period of 180 days.

2.2 MATERIALS

A. Oriented Strand Board: DOC PS 2, made with binder containing no added urea formaldehyde.

B. Rigid Foam Plastic Insulating Board: Rigid polyisocyanurate foam core complying with ASTM C1289 Type II, Class 2, and ICC-ES AC12, with coated glass fiber facers on both sides, with the following characteristics:

1. Nominal Density: 2.0 pcf (32 kg/cu. m).
2. Compressive Strength, ASTM D1621: Not less than 20 psi (150 kPa).
3. Vapor Permeance, ASTM E96/E96M: Less than 1.0 perm.
4. Edge Configuration: Square finished.

2.3 COMPOSITE INSULATING WALL SHEATHING

A. Composite Insulating Wall Sheathing: Oriented-strand-board Exposure 1 sheathing 7/16 inch (11.1 mm) thick, with factory-laminated water-resistive barrier exterior facer, and with rigid foam plastic insulating board laminated to interior face.

1. Basis-of-Design: Huber Engineered Woods LLC; ZIP System R Sheathing, or approved equal.
2. Span Rating and Performance Category of Sheathing Layer: Not less than 24/16; 7/16 Performance Category.
3. Thickness: 1-1/2 inch (38 mm)
4. Thermal Resistivity (R Value): 6 deg F x h x sq. ft./Btu x in. at 75 deg F.
5. Edge Profile: Square edge.
6. Exterior Facer: Medium-density, phenolic-impregnated polymer-modified sheet material meeting requirements for ASTM D779 Grade D weather-resistive barrier in accordance with ICC AC38 and AC310, with fastener spacing symbols on exterior facer for 16-inch (406 mm) on center spacing, with the following characteristics

a. Water Resistance of Coatings, ASTM D2247: Pass 14 day exposure test.
b. Moisture Vapor Transmission, ASTM E96: Not less than 12 perms.
c. Water Penetration, ASTM E331: Pass at 2.86 lbf/sq. ft. (137 Pa).
d. Wind Driven Rain, TAS-100: Pass.
e. Accelerated Weathering, ASTM G154: Pass.

2.4 FASTENERS

A. Fasteners, General: Size and type complying with manufacturer's written instructions for Project conditions and requirements of authorities having jurisdiction.

1. Corrosion Resistance: [Hot-dip zinc coating, ASTM A153/A 153M] [or] [Type 304 stainless steel].

B. Nails, Brads, and Staples: ICC AC116 and ICC AC201.

C. Power-Driven Fasteners: ICC-ES-1539 or NER-272.

2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIAL

A. Self-Adhering Seam and Flashing Tape: Pressure-sensitive, self-adhering, cold-applied, seam tape consisting of polyolefin film with acrylic adhesive, meeting ICC AC148.

1. Basis-of-Design Product: Huber Engineered Woods; ZIP System Tape, or approved equal.
2. Thickness: 0.012 inch (0.3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing spacing and alignment to determine if work is ready to receive sheathing. Proceed with sheathing work once conditions meet requirements.

3.2 SHEATHING INSTALLATION

A. Install sheathing panels in accordance with manufacturer's written instructions, requirements of applicable Evaluation Reports, and requirements of authorities having jurisdiction.

B. Air and Moisture Barrier: Coordinate sheathing installation with flashing and joint sealant installation and with adjacent building air and moisture barrier components to provide complete, continuous air- and moisture- barrier.

C. Do not bridge expansion joints; allow joint spacing equal to spacing of structural supports.

D. Install panels with laminated facer to exterior. Stagger end joints of adjacent panel runs.

E. Attach sheathing panels securely to substrate with manufacturer-approved fasteners in compliance with the following:

1. ICC-ES ESR-1539 or ICC-NES NER-272 for power-driven fasteners.
2. IBC: Table 2304.9.1 Fastening Schedule.

F. Apply seam tape at all panel seams, penetrations, and facer defects or cracks to form continuous weathertight surface. Apply tape according to manufacturer's written instructions and requirements of ICC-ES applicable to tape application.

END OF SECTION

SECTION 06 17 15 - ENGINEERED STRUCTURAL WOOD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural composite lumber.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Research reports.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that is capable of meeting the standards of **a recognized** quality-assurance program, complies with quality-control procedures in ASTM D5055 or ASTM D5456, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 STRUCTURAL COMPOSITE LUMBER

A. General: Provide structural composite lumber that complies with ASTM D5456 and ASTM D2559 or research/evaluation reports acceptable to authorities having jurisdiction.

B. Laminated-Veneer Lumber (LVL): Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored in accordance with ASTM D5456, and manufactured with exterior-type adhesive complying with ASTM D2559.
1. Allowable Stresses:

a. Extreme Fiber Stress in Bending, Edgewise (Fb): 2600 psi for 12-inch nominal-(286-mm actual-) depth members.
b. Modulus of Elasticity, Edgewise (E): 2,000,000 psi (13 700 MPa).

2. Moisture Protection: Factory seal face, edge and ends with manufacturer's standard water-resistant coating.

3. LVL lumber used in exterior use or exposed to weather shall be pressure-treated.

C. Parallel-Strand Lumber (PSL): Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored in accordance with ASTM D5456, and manufactured with exterior-type adhesive complying with ASTM D2559.
1. Allowable Stresses:

a. Extreme Fiber Stress in Bending, Edgewise (Fb): <2400 psi> for 12-inch nominal- (286-mm actual-) depth members.
b. Modulus of Elasticity, Edgewise (E): 1,800,000 psi (12 400 MPa).

2. Moisture Protection: Factory seal **face,** edge and ends with manufacturer's standard water-resistant coating.

3. PSL lumber used in exterior use or exposed to weather shall be pressure-treated.

2.2 FASTENERS

A. General: Fasteners are to be of size and type indicated and to comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Where rough 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 A153/A153M or ASTM F2329, or of Type 304 stainless steel.
2. For pressure-preservative-treated wood, use stainless steel fasteners.

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. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

E. Carbon Steel Bolts: ASTM A307 with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flat washers all hot-dip zinc coated.

F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 (ASTM F836M, Grade A1 or Grade A4) hex nuts and, where indicated, flat washers.

G. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

2.3 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, are to meet or exceed those indicated of basis-of-design products. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed

by qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.

B. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch (25 mm) above base and with 2-inch- (50-mm-) minimum side cover, socket 0.062 inch (1.6 mm) thick, and standoff and adjustment plates 0.108 inch (2.8 mm) thick, unless otherwise noted

C. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Width: 1-1/4 inches (32 mm).
2. Thickness: 0.062 inch (1.6 mm).
3. Length: As indicated.

D. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 (Z180) coating designation.

   a. Use for interior locations unless otherwise indicated.

2. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; 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 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
3. Stainless steel bars and shapes complying with ASTM A276/A276M, Type 304 or Type 316.

   a. Use for exterior locations and where indicated.

2.4 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:
1. Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION OF STRUCTURAL COMPOSITE LUMBER

A. Install to comply with ESR report, manufacturer's written instructions, and applicable code.

1. Install in dry, covered conditions where average in-service moisture content of lumber is 16 percent or less.
2. Install metal framing connections in accordance with AWC's "National Design Specification (NDS) for Wood Construction." Install fasteners through each fastener hole.

3. Install lumber plumb and level. Accurately fit, align, securely fasten, and install free from distortion or defects.
4. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

B. Cutting: Confirm size and location of field cutting, notching, and drilling with ESR report, registered design professional, and manufacturer.

END OF SECTION 06 17 15

SECTION 06 40 13 - EXTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior standing and running trim.
2. Exterior stairs and railings.
3. Wood furring, blocking, shims, and hanging strips for installing exterior architectural woodwork items that are not concealed within other construction.
4. Shop priming of exterior architectural woodwork.
5. Shop finishing of exterior architectural woodwork.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Wood-Preservative Treatment:

a. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
b. Indicate type of preservative used and net amount of preservative retained.
c. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.

2. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Shop Drawings:

1. Include dimensioned plans, elevations, sections, and attachment details.

C. Samples: For each exposed product and for each color and finish specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For architectural woodwork manufacturer.

1.4 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 mockups of typical exterior architectural woodwork as shown on Drawings.

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.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of exterior architectural woodwork indicated for construction, finishes, installation, and other requirements.

2.2 EXTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Premium.

B. Backout or groove backs of flat trim members, and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

C. Wood Species: Eastern white pine, sugar pine, or western white pine and any closed-grain hardwood.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.
2. Wood Moisture Content: 9 to 15 percent.

2.3 EXTERIOR STAIRS AND RAILINGS

A. Architectural Woodwork Standards Grade: **Premium**.

B. 3/4-inch- (19-mm-) actual thickness radius-edged S4S boards, with one face free of planer skip, machine burn, and torn or chipped grain.

1. Species: **Ipe or Cumaru**.
2. Grade Characteristics:
   a. Sound; small pin knots, worm holes, and fixed knots allowed.
   b. Straight grained and parallel cut.
   c. No decay, incipient decay, honeycomb, knot holes, shakes, splits, or wane.
   d. No discoloration.

Stair risers paragraphs.

C. 3/4-inch- (19-mm-) actual thickness radius-edged S4S boards, with one face free of planer skip, machine burn, and torn or chipped grain.

1. Species: **Ipe or Cumaru**.
2. Grade Characteristics:
   a. Sound; small pin knots, worm holes, and fixed knots allowed.

b. Straight grained and parallel cut.
c. No decay, incipient decay, honeycomb, knot holes, shakes, splits, or wane.
d. No discoloration.

Railing members paragraphs.

D. Radius-edged Ipe Teak S4S boards, straight grained and parallel cut.

Balusters paragraphs below

E. 1-1/16-inch- (27-mm-) square, clear, kiln-dried, solid, pressure-preservative-treated southern pine.

2.4 WOOD MATERIALS

A. Hardboard: ANSI A135.4.

B. Softwood Plywood: DOC PS 1, exterior, medium-density overlay.

2.5 PRESERVATIVE-TREATED-WOOD MATERIALS

A. Preservative-Treated-Wood Materials: Provide with water-repellent preservative treatment complying with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment).

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC).
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

B. Extent of Preservative-Treated Wood Materials: Treat wood materials unless otherwise indicated on Drawings.

1. Items fabricated from the following wood species need not be treated:
   a. Ipe.
   b. Teak.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Use stainless steel unless otherwise indicated.

B. Nails: ASTM F1667.

C. Power-Driven Fasteners: ICC-ES AC70.

D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

E. Carbon Steel Bolts: ASTM A307 with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flat washers all hot-dip zinc coated.

2.7 MISCELLANEOUS MATERIALS

A. Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

1. Wood-Preservative Treatment: By pressure process, AWPA U1; Use Category UC3b.

a. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
b. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
c. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

2.8 FABRICATION

A. Fabricate exterior 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 (1.5 mm) unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

2.9 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 exterior architectural woodwork, as applicable to each unit of work.

B. Backpriming: Apply one coat of sealer or primer, 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.

C. Exterior Architectural Woodwork for Opaque Finish: Shop prime all surfaces with one coat of wood primer as specified in Section 099113 "Exterior Painting."

2.10 SHOP FINISHING

A. Finish exterior architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing exterior 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 exterior architectural woodwork. Apply two coats to end-grain surfaces.

C. Opaque Finish: Comply with Section 099113 "Exterior Painting."

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition exterior architectural woodwork to average prevailing humidity conditions at Project site.

B. Before installing exterior architectural woodwork, examine shop-fabricated work for completion, and complete work as required, including removing packing and backpriming concealed surfaces.

3.2 INSTALLATION

A. Grade: Install exterior architectural woodwork to comply with same grade as item to be installed.

B. Assemble exterior architectural woodwork, and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install exterior 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 (3 mm in 2400 mm).

D. 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 (1500 mm) long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.

E. Scribe and cut exterior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Preservative-Treated Wood Materials: Where field cut or drilled, treat cut ends and drilled holes in accordance with AWPA M4.

G. Anchor exterior 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 exterior architectural woodwork.
3. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.
4. For shop-finished items, use filler matching finish of items being installed.

H. Stair and Railing Installation:

1. Treads and Risers:

a. Install stair tread with crown side up (bark side down).
b. Secure treads and risers by gluing and nailing to carriages.

1) Extend treads over carriages and finish with bullnose edge.

c. Countersink nail heads, fill flush, and sand filler.

2. Balusters:

a. Fit balusters to treads, glue, and nail in place.
b. Countersink nail heads, fill flush, and sand filler.
c. Let into railings and glue in place.

3. Newel Posts: Secure newel posts to stringers and risers with through bolts.
4. Railings:

a. Secure wall rails with metal brackets.
b. Fasten freestanding railings to newel posts and to trim at walls with glue and countersunk-head wood screws or rail bolts.

5. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.
6. Install stairs with no more than 3/16-inch (4.7-mm) variation between adjacent treads and risers and with no more than 3/8-inch (10-mm) variation between largest and smallest treads and risers within each flight.

I. Touch up finishing work specified in this Section after installation of exterior 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.

J. Field Finishing: See Section 099113 "Exterior Painting" for final finishing of installed exterior architectural woodwork.

END OF SECTION 06 40 13

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 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.

PART 2 - PRODUCTS

2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet Waterproofing: Minimum 60-mil (1.5-mm) nominal thickness, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated on one side to a 4-mil- (0.10-mm-) 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. Physical Properties:

   a. Tensile Strength, Membrane: 250 psi (1.7 MPa) minimum; ASTM D412, Die C, modified.
   b. Ultimate Elongation: 300 percent minimum; ASTM D412, Die C, modified.
   c. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D1970/D1970M.
   d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C836/C836M.
   e. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E154/E154M.
   f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D570.
   g. Water Vapor Permeance: 0.05 perm (2.9 ng/Pa x s x sq. m) maximum; ASTM E96/E96M, Water Method.

2. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.2 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.

D. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

PART 3 - EXECUTION

3.1 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.

3.2 INSTALLATION OF MODIFIED BITUMINOUS SHEET-WATERPROOFING

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions.

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- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), 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 (16 deg C).

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 (150 mm) beyond repaired areas in all directions.

H. Immediately install protection course with butted joints over waterproofing membrane.

I. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

J. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071326

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Mineral-wool blanket insulation.
3. Accessories

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Extruded polystyrene foam-plastic board insulation.
2. Mineral-wool blanket insulation.
3. Accessories

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

B. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type VI: ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength

2.3 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Reinforced-Foil Faced: ASTM C665, Type III (reflective faced); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

1. Basis of Design;
   a. Comfort Batt by Rockwool, or approved equal.

2.4 ACCESSORIES

A. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between vented eaves.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

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.

3.2 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 48 inches (1220mm) below exterior grade line.

3.3 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.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer.

1. Fit courses of insulation between obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to 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 (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. For wood-framed construction, install blankets according to ASTM C1320 and as follows:

    a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward as indicated on Drawings.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 07 21 00

SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Closed-cell spray polyurethane foam.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. (24 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F (25 mm of 43 K x sq. m/W at 24 deg C).

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.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

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.

END OF SECTION 07 21 19

SECTION 07 25 00 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Flexible flashing

1.2 ACTION SUBMITTALS

A. Product data.

B. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 FLEXIBLE FLASHING

A. Rubberized-Asphalt Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (0.8 mm).

   1. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.

PART 3 - EXECUTION

3.1 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

   1. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
   2. Lap flashing over water-resistive barrier at bottom and sides of openings.
   3. Lap water-resistive barrier over flashing at heads of openings.

END OF SECTION 072500

SECTION 07 31 13 - 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. Metal roof flashing and trim.

1.3 DEFINITION

A. 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 SUBMITTALS

A. Warranties: Sample of special warranties. Section 013300 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data indicating material characteristics, performance criteria, and limitations.

C. Samples: Submit two 2 x 3 foot samples of each shingle color indicating color range and finish texture/pattern; for color and texture selection.

D. Manufacturer's Installation Instructions: Submit installation criteria and procedures.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer must be approved for installation of all roofing products to be installed under this section.

B. Source Limitations: Obtain ridge and hip cap shingles from single source from single manufacturer.

C. Regulatory Requirements

1. Provide a roofing system achieving an Underwriters Laboratories (UL) Class A fire classification.

2 Install all roofing products in accordance with all federal, state and local building codes.

3 Exterior Fire-Test Exposure: Class C; ASTM E 108 or UL 790, for application and roof slopes indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store all products in manufacturer's unopened, labeled packaging until they are ready for installation.

B. Store roofing materials in a dry, well-ventilated, weather-tight location according to asphalt shingle manufacturer's written instructions at temperatures no greater than 110 degrees Fahrenheit. Do not store in direct sunlight. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.

C. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.

D. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install asphalt shingles until spaces are enclosed and weather-tight.

1.8 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Manufacturing defects.
b. Structural failures including failure of asphalt shingles to self-seal after a reasonable time

B. Material Warranty Period: from date of Substantial Completion, 100% non-prorated coverage for materials and labor for the first 20 years, then prorated thereafter for lifetime shingles.

C. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds up to 130 mph for ten years from date of Substantial Completion.

D. Algae-Discoloration Warranty Period: Asphalt shingles will not discolor ten years from date of Substantial Completion.

1.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Asphalt Shingles: 100 sq. ft of each type, in unbroken bundles.

PART 2 - PRODUCTS

2.1 HEAVYWEIGHT GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Laminated-Strip Asphalt Shingles: ASTM D 3462, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.

B. ACCEPTABLE MANUFACTURERS AND PRODUCTS

1. Certainteed Landmark Pro laminated asphalt shingles. Color: Max Def Pewterwood.

2. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.2 ACCESSORIES

A. All products to be single source where possible from roofing manufacturer or approved by roofing manufacturer. Must not nullify manufacturer’s warranty.

B. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

C. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, or copper, wire shingle nails, minimum 0.120-inch- diameter, barbed or smooth shank, sharp-pointed, with a minimum 3/8-inch- diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

D. Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile disc caps, 1-inch minimum diameter.

2.3 METAL FLASHING AND TRIM

A. General:

1. Sheet Metal: Aluminum, mill finish; Kynar colored finish to match wall surface where exposed.

2. Aluminum drip edge – Color: white, to match trim.

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. Step Flashings: Fabricate with a head lap of 2 inches and a minimum extension of 4 inches over the underlying asphalt shingle and up the vertical surface.
2. Cricket Flashings: Fabricate with concealed flange extending a minimum of 24 inches beneath upslope asphalt shingles and 6 inches beyond each side of chimney and 8 inches above the roof plane.
3. Open-Valley Flashings: Fabricate in lengths not exceeding 10 feet with 1-inch- high, inverted-V profile at center of valley and equal flange widths of 12 inches.
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: Pipes penetrating shingles roofs shall be flashed with ARFCO self sealing neoprene collar with aluminum flange.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until the roof deck has been properly prepared.

B. If roof deck preparation is the responsibility of another installer, notify the architect or building owner of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Remove all existing roofing down to the roof deck

B. Verify that the deck is dry, sound, clean and smooth. It shall be free of any depressions, waves, and projections. Cover with sheet metal, all holes over 1 inch (25 mm) in diameter, cracks over ½ inch (12mm) in width, loose knots, and excessively resinous areas.

C. Replace damaged deck with new materials

D. Clean deck surfaces thoroughly prior to installation of eaves protection membrane and underlayment.

3.3 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 Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 6 inches over underlying course. Lap ends a minimum of 20 inches. Stagger end laps between succeeding courses at least 72 inches.

1. Install 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 to shed water. Lap ends of felt not less than 6 inches over self-adhering sheet underlayment.
2. Install fasteners at no more than 36 inches o.c.

C. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated on Drawings and as indicated below, lapped in direction to shed 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. Eaves: Extend from edges of eaves 36 inches beyond interior face of exterior wall.
2. Rakes: Extend from edges of rake 36 inches beyond interior face of exterior wall.
3. Valleys: Extend from lowest to highest point 18 inches on each side.
4. Hips: Extend 18 inches on each side.
5. Dormers, Chimneys, and Other Roof-Penetrating Elements: Extend beyond penetrating element 18 inches, and return vertically against penetrating element not less than 4 inches.

D. Metal-Flashed, Open-Valley Underlayment: Install two layers of 36-inch- wide felt underlayment centered in valley. Stagger end laps between layers at least 72 inches. Lap ends of each layer at least 12 inches in direction to shed water, and seal with asphalt roofing cement. Fasten each layer to roof deck.

1. Lap roof-deck felt underlayment over first layer of valley felt underlayment at least 6 inches.

3.4 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim."

1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Step Flashings: Install with a head lap of 2 inches and extend over the underlying asphalt shingle and up the vertical surface. Fasten to roof deck only.

C. Cricket Flashings: Install against the roof-penetrating element extending concealed flange beneath upslope asphalt shingles and beyond each side.

D. Open-Valley Flashings: Install centered in valleys, lapping ends at least 8 inches in direction to shed water. Fasten upper end of each length to roof deck beneath overlap.

1. Secure hemmed flange edges into metal cleats spaced 12 inches apart and fastened to roof deck.
2. Adhere 9-inch- wide strip of self-adhering sheet to metal flanges and to self-adhering sheet underlayment.

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.

3.5 ASPHALT SHINGLE INSTALLATION

A. Shingles are to be hand-nailed – not stapled.

B. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

C. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with tabs removed with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 3/4 inch over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

D. Install first and remaining courses of asphalt shingles in stair-stepping pattern diagonally across roof deck with manufacturer’s recommend offset pattern at succeeding courses, maintaining uniform exposure.

E. Fasten asphalt shingle strips with a minimum of six roofing nails located according to manufacturer's written instructions.
1. When ambient temperature during installation is below 50 deg F, seal asphalt shingles with asphalt roofing cement spots.

F. Ridge and Hip Cap 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.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 017300 - Execution: Protecting installed construction.

B. Do not permit traffic over finished roof surface.

END OF SECTION 07 31 13

SECTION 07 44 56 – FIBER CEMENT PANEL ACCESSORIES

PART 1 — GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fiber Cement Panel Profiles

1.2 SUBMITTALS

A. Product Data: indicate product description, including compliance with specified requirements and installation requirements. Mark manufacturer's brochures to include only those products proposed for use.

1.3 QUALITY ASSURANCE

A. Applicable standards; standards of the following, as referenced herein:

1) Aluminum Association (AA).
2) American Society for Testing and Materials (ASTM).

B. Allowable tolerances in horizontal planes:

1) Variation from level: +⅛" in 12'-0".

C. Allowable tolerances in framed vertical construction.

1) Position: +¼" maximum variation from design position.
2) Alignment: ⅛" in 8'-0"; ¼" maximum in any continuous wall, line, or surface.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage:

1) Stack accessories off floor on pallets or similar platforms providing continuous support for accessories to prevent sagging. Stack accessories so that long lengths are not over short lengths.
2) Handle materials to prevent damage to surfaces, edges, and ends of aluminum trims. Reject and remove damaged material from site.

PART 2 — PRODUCTS

2.1 FIBER CEMENT PANEL PROFILES

A. General: Extruded aluminum profiles rated for exterior application. Compatible with 5/16” fiber cement panels.

1. Basis of Design: Fry Reglet Corporation, or approved equal.

B. Finish: Factory-appplied powder paint finish in color as selected by Architect from full range.

C. Profiles: Provide the following profiles at locations indicated on the Drawings.

1. T1 F Molding: 1/2” reveal

2. V2 Vertical Molding: 1/2” reveal

3. H5 Double Horizontal: 1/2” reveal

2. H10 Base Trim

3. OC1 Outside Corner

PART 3 — EXECUTION

3.1 INSTALLATION

A. 5/16” Fiber Cement Panels: Install panel accessories in accordance with panel manufacturer’s supplemental installation details for commercial applications and as follows:

1) F Molding: Install as a vertical termination trim as indicated on drawings.
2) Vertical Molding: Install as a vertical divider between fiber cement panels as indicated on drawings.
3) Double Horizontal: Install between tops and bottoms of fiber cement panels as indicated on drawings.
4) Base Trim: Install as horizontal termination trim at bottom of fiber cement panels as indicated on drawings.
5) Outside corner trim: Install at designated corners as indicated on drawings.

3.2 PROTECTION:

A. Protect accessories from damage until date of substantial completion. Replace accessories which become damaged.

SECTION 07 46 46 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Fiber-Cement Lap Siding
2. Fiber-Cement Panel
3. Multipurpose Fiber-Cement Panel
4. Fiber-Cement Soffit

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For fiber-cement siding and soffit including related accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT LAP SIDING

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested in accordance with ASTM E136; with a flame-spread index of 25 or less when tested in accordance with ASTM E84.

1. Basis of Design:
   a. Magnolia Home by James Hardie, or approved equal.

B. Labeling: Provide fiber-cement siding that is tested and labeled in accordance with ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: Not less than 5/16 inch (8 mm).

D. Horizontal Pattern: Boards 5-1/4 inches (133 mm) wide in plain style.

1. Texture: Smooth.

E. Exposure: 4 inches (100 mm).

F. Factory Primed and Finished: Color as selected by Architect from full range.

2.2 FIBER-CEMENT PANEL

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested in accordance with ASTM E136; with a flame-spread index of 25 or less when tested in accordance with ASTM E84.

1. Basis of Design:
   a. James Hardie, or approved equal.

B. Labeling: Provide fiber-cement siding that is tested and labeled in accordance with ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: Not less than 5/16 inch (8 mm).

D. Panel Texture: 48-inch- (1200-mm-) wide sheets with smooth texture.

E. Factory Primed and Finished: Color as selected by Architect from full range.

2.3 MULTIPURPOSE FIBER-CEMENT PANEL

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested in accordance with ASTM E136; with a flame-spread index of 25 or less when tested in accordance with ASTM E84; Rated for ground contact and below-grade installation.
   1. Basis of Design:
      a. Finex, or approved equal.

B. Labeling: Provide fiber-cement siding that is tested and labeled in accordance with ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: Not less than 1/2 inch (12 mm).

D. Panel Texture: 48-inch- (1200-mm-) wide sheets with smooth texture.

E. Finish: Color as selected by Architect from full range.

2.4 FIBER-CEMENT SOFFIT

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested in accordance with ASTM E136; with a flame-spread index of 25 or less when tested in accordance with ASTM E84.

   1. Basis of Design: James Hardie

B. Nominal Thickness: Not less than 5/16 inch (8 mm).

C. Pattern: 12-inch- (300-mm-) wide sheets with non-vented, smooth texture.

D. Factory Primed and Finished: Color as selected by Architect from full range.

2.5 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration. Color as selected by Architect.

B. Flashing, General: Provide flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

   1. Finish for Aluminum Flashing: Siliconized polyester coating in color to match adjacent trim.

C. Fasteners, General:
   1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch (25 mm) into substrate.
   2. For fastening fiber cement panels, use fasteners of material and sufficient length recommended by manufacturers.

D. Multipurpose Fiber-Cement Panels:

1. Provide Finishing Compound to conceal fasteners.
2. Provide flexible sealant recommended by manufacturer for between panels.

E. Insect Screening for Soffit Vents: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh.

F. Continuous Soffit Vents: Aluminum, hat-channel shape.
1. Net-Free Area: 4 sq. in./linear ft. (280 sq. cm/m).
2. Finish: White paint.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
1. Install fasteners no more than 24 inches (600 mm) o.c.

B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.2 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 07 46 46

SECTION 07 53 23 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanically fastened ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Accessory roofing materials.
3. Roof insulation.
4. Insulation accessories.

1.2 PREINSTALLATION MEETINGS

A. Preliminary Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness if insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane and fastening spacings and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

B. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

    a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: A qualified manufacturer that is listed in SPRI's Directory of Roof Assemblies for roofing system identical to that used for this Project.
2. Installers: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 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. Warranty Period: 15 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane to resist impact damage when tested in accordance with ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

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:

1. Zone 1 (Roof Area Field): 90 **lbf/sq. ft.**.
2. Zone 2 (Roof Area Perimeter): 90 **lbf/sq. ft**.

a. Location: From roof edge to five feet inside roof edge.

D. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.

1. Wind Uplift Load Capacity: 90 psf.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

A. EPDM Sheet: ASTM D4637/D4637M, Type II, scrim or fabric internally reinforced, EPDM sheet with factory-applied seam tape.

1. Thickness: 60 mils (1.5 mm), nominal.
2. Exposed Face Color: Black.

2.3 ACCESSORY ROOFING MATERIALS

A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard.

E. Seaming Material: Factory-applied seam tape, width as recommended by manufacturer.

F. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

H. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.

J. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.4 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. (23-kg/cu. m) minimum density, 25 psi (173 kPa) minimum compressive strength square edged.

1. Basis of Design: DOW “Styrofoam”
2. Thermal Resistance: R-value of 5.0 per 1 inch (25.4 mm).
3. Size: 48 by 96 inches (1219 by 2438 mm).
4. Thickness:

a. Base Layer: 1-1/2 inches (38 mm).

B. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6.35 mm).
3. Slope:

a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES AND COVER BOARD

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer.

C. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

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.

3.2 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system in accordance with roofing system manufacturer's written instructions, SPRI's Directory of Roof Assemblies 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.

3.3 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck in accordance with recommendations in SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof in accordance with roofing system manufacturers' written instructions.

3.4 INSTALLATION OF INSULATION

A. Coordinate installing 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 instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows.

    a. Locate end joints over crests of decking.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    f. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

        1) Fasten insulation in accordance with requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
        2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.

b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. 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 (610 mm).
f. Trim insulation so that water flow is unrestricted.
g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
i. Adhere each layer of insulation to substrate using adhesive in accordance with SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

    1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing in accordance with roofing system manufacturer's written instructions.

B. Unroll membrane roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

1. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

H. Factory-Applied Seam Tape Installation: Clean and prime surface to receive tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

I. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

J. Adhere protection sheet over roof membrane at locations indicated.

3.6 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates in accordance with roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. 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.

C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

3.8 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.

END OF SECTION 07 53 23

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.
2. Formed low-slope roof sheet metal fabrications.
3. Formed wall sheet metal fabrications.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.

B. 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 edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long by actual width.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested.

B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Special warranty.

1.6 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. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested, shop is to be listed as able to fabricate required details as tested and approved.

1.7 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 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. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to 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 are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

E. 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.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

C. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.

2. Color: Provide (2) colorways as selected by Architect from the manufacturer's standard range. Refer to Contract Drawings for locations.
3. 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 (0.013 mm).

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over

220 deg F (111 deg C); and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.

C. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) 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 in accordance with underlayment manufacturer's written instructions.

1. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (minus 29 deg C) or lower.

D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, 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 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.

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 Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Solder:

1. For Copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Elastomeric Sealant: ASTM C920, 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. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

F. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

G. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions.

1. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
2. Accessories:

a. 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 Drawings show reglet without metal counterflashing.
b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

3. Finish: With manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. 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.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. 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.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. 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 (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

A. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

1. Lap horizontal joints not less than 4 inches (100 mm).
2. Lap end joints not less than 12 inches (300 mm).

B. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses.
5. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

C. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than 4 inches (100 mm).

3.2 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
6. Space individual cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.

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. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. 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.

1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
3. 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 (32 mm) for nails and not less than 3/4 inch (19 mm) 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.

a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pretin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pretinning where pretinned surface would show in completed Work.
2. Do not solder aluminum sheet.
3. Do not use torches for soldering.
4. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

5. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

3.3 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches (100 mm) over base flashing.
3. Lap counterflashing joints minimum of 4 inches (100 mm).

D. 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.

3.4 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with 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. Opening Flashings in Frame Construction: Install continuous head, and sill similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.5 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

3.7 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. 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, as determined by Architect.

END OF SECTION 07 62 00

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

B. Preinstallation Conference: Conduct conference at Project site.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. 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.

C. Samples: For each type of roof specialty and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests performed by a qualified testing agency.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are SPRI ES-1 tested to specified design pressure.

1.6 WARRANTY

A. 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 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. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. SPRI Wind Design Standard: Manufacture and install roof-edge specialties tested in accordance with SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As required by applicable building code.

B. 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 (67 deg C), ambient; 180 deg F (100 deg C), 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 12 feet (3.6 m) 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: Hickman Edge Systems; TerminEdge Drip Edge EX
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: Furnish (2) colors, as selected by Architect from manufacturer's Standard and/or Express Colors range.

d. Height: As indicated on the drawings.

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. Fascia Accessories: Downspout scuppers with integral conductor head and downspout adapters.

2.3 ROOF-EDGE DRAINAGE SYSTEMS

A. Basis of Design: Hickman Edge Systems; Chamfer Gutter

B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet (3.6 m), with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Aluminum Sheet: 0.063 inch (1.60 mm) thick.
2. Corners: Factory mitered and mechanically clinched and sealed watertight.
3. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
4. Gutter Accessories: Wire ball downspout strainer.

C. Downspouts: Plain rectangular complete with machine-crimped mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Formed Aluminum: 0.050 inch (1.27 mm) thick.

D. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge, and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout, exterior flange trim, and built-in overflow.

1. Formed Aluminum: 0.032 inch (0.81 mm) thick.

E. Aluminum Finish: Two-coat fluoropolymer.

1. Color: Furnish (2) colors, as selected by Architect from manufacturer’s Standard and/or Express Colors range.

2.4 COUNTERFLASHINGS

A. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).

B. Copper Finish: Non-patinated, mill.

2.5 MATERIALS

A. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

2.6 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) 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.

B. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.

B. Solder for Copper: ASTM B32, lead-free solder.

2.8 FINISHES

A. Copper Sheet Finishes:

1. Non-Patinated Finish: Mill finish.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

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 (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under roof-edge specialties and counterflashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

3.2 INSTALLATION, GENERAL

A. Install roof specialties in accordance with 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. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

C. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

A. Install components to produce a complete roof-edge drainage system in accordance with manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches (305 mm) apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.

D. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

E. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch (25 mm) below discharge.

3.4 INSTALLATION OF COUNTERFLASHINGS

A. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.5 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.

END OF SECTION 07 71 00

SECTION 077129 - MANUFACTURED ROOF EXPANSION JOINTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flanged bellows-type roof expansion joints.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roof expansion joints.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer of roofing membrane.

1.6 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FLANGED BELLOWS-TYPE ROOF EXPANSION JOINTS

A. Flanged Bellows-Type Roof Expansion Joint: Factory-fabricated, continuous, waterproof joint cover consisting of exposed membrane bellows laminated to flexible, closed-cell support foam, and secured along each edge to 3- to 4-inch- (76- to 100-mm-) wide metal flange.

1. Basis of Design: as manufactured by Best Materials with 5” EPDM bellow #95905.
2. Source Limitations: Obtain flanged bellows-type roof expansion joints approved by roofing manufacturer and that are part of roofing membrane warranty.
3. Bellows: EPDM flexible membrane, nominal 60 mils (1.5 mm) thick.
4. Flanges: Copper, 16 oz./sq. ft. (0.55 mm) thick.
5. Corner, Intersection, and Transition Units: Provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints.
6. Accessories: Provide splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation.
7. Secondary Seal: Continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary bellows assembly.

B. Materials:

1. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

2. EPDM Membrane: ASTM D4637/D4637M, type standard with manufacturer for application.

2.2 MISCELLANEOUS MATERIALS

A. Adhesives: As recommended by roof-expansion-joint manufacturer.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.

1. Exposed Fasteners: Gasketed. Use screws with hex washer heads matching color of material being fastened.

C. Mineral-Fiber Blanket: ASTM C665.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions for handling and installing roof expansion joints.

1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.
2. Install roof expansion joints true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
3. Provide for linear thermal expansion of roof-expansion-joint materials.

B. Directional Changes: Install factory-fabricated units at directional changes to provide continuous, uninterrupted, and watertight joints.

C. Splices: Splice roof expansion joints to provide continuous, uninterrupted, and waterproof joints.

1. Install waterproof splices and prefabricated end dams to prevent leakage of secondary-seal membrane.

D. 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.

END OF SECTION 077129

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

1.2 ACTION SUBMITTALS

A. Product data.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

1.3 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test in accordance with testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Penetration firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.

        1) UL in its online directory "Product iQ."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Description: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems are to be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor penetrated.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined in accordance with UL 1479.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, in accordance with ASTM E84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS

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. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

C. 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 ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

D. 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.

3.2 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any 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.

3.3 FIELD QUALITY CONTROL

A. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

B. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 07 92 00 - JOINT SEALANTS

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Latex joint sealants.

1.2 ACTION SUBMITTALS

A. Product data.

B. Samples: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Joint-sealant schedule.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

1.6 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: Five years from date of Substantial Completion.

B. 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 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
   1. Basis of Design: DOWSIL 795 Silicone sealant as manufactured by Dow Chemical Co.

2.3 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

2.4 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 C1330, Type C (closed-cell material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.5 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 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.

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.
    b. Glass.

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.

3.2 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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type 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 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.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with 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 in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
4. Provide recessed joint configuration of recess depth and at locations indicated on Drawings in accordance with Figure 8C in ASTM C1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

F. 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.

G. 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.

3.3 FIELD QUALITY CONTROL

A. Inspections:

    a. Inspect joints and report on the following:

1) Whether sealants filled joint cavities and are free of voids.
2) Whether sealant dimensions and configurations comply with specified requirements.
3) 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.

b. Record 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.
c. 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.

END OF SECTION 079200

SECTION 08 03 52 - HISTORIC TREATMENT OF WOOD WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of wood windows in the form of the following:

1. Repairing wood windows and trim.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 01 22 00 "Unit Prices."

1.3 DEFINITIONS

A. Window: Includes window frame, sash, hardware, trim, storm window, and exterior and interior shutters unless otherwise indicated by context.

B. Exterior Trim: Exterior casing, brick mold, and cornice or drip cap.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of wood windows and fire protection.
2. Review methods and procedures related to historic treatment of wood windows.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic wood window specialist, experienced in repairing, refinishing, and replacing wood windows in whole and in part. Experience only in fabricating and installing new wood windows is insufficient experience for wood-window historic treatment work.

B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service

representatives who are available for consultation and Project-site inspection and on-site assistance.

C. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

1. Wood Window Repair: Prepare one entire window unit to serve as mockup to demonstrate samples of each type of repair of wood window members including frame, sash, glazing, and hardware.

PART 2 - PRODUCTS

2.1 HISTORIC TREATMENT OF WOOD WINDOWS, GENERAL

A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grades of wood windows, and other requirements unless otherwise indicated.

1. Exception: Industry practices cited in Section 12, Article 1.5, Industry Practices, of the Architectural Woodwork Standards do not apply to the work of this Section.

2.2 SHUTTERS

A. General: Stile and rail units, replicating appearance of existing units, with concealed fasteners.

B. Exterior Wood Shutters: Custom fabricated, tight fitting, and with operating and latching hardware.

1. Operation: Match existing.
2. Panel Configuration: Match design reference sample.
3. Joint Construction: Joints matching existing.
4. Wood Species: Match wood species of exterior trim and sash parts.
5. Wood Shutter Members: Match wood profiles of existing shutters.
6. Wood Preservative: Apply borate preservative treatment to accessible surfaces of exterior wood shutters before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
7. Hardware: Reuse existing.

2.3 WOOD-REPLACEMENT MATERIALS

A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.

1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

2.4 WOOD-REPAIR MATERIALS

A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

B. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

2.5 GLAZING MATERIALS

A. Glass: Reset existing glass panels.

B. Glazing Systems:

1. Traditional Glazing Products: Glazing points and oil-based glazing putty or latex glazing compound. Tint to required color according to manufacturer's written instructions.

2.6 HARDWARE

A. Window Hardware: Provide complete sets of window hardware consisting of sash balances, hinges, pulls, latches, and accessories indicated for each window or required for proper operation. Sets shall include replacement hardware to complement repaired and refinished, existing hardware. Window hardware shall smoothly operate, tightly close, and securely lock wood windows and be sized to accommodate sash or ventilator weight and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.

C. Material and Design:

1. Material: Solid bronze of alloy indicated unless otherwise indicated.
2. Design: Match type and appearance of existing hardware.
3. Weight and Pulley Sash-Balance: Concealed weight and pulley balance system including steel or cast iron weights, cast-bronze pulleys, synthetic sash cord or sash chain; size and capacity to hold sash stationary at any open position.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.7 WEATHER STRIPPING

A. Metal Weather Stripping: Zinc weather stripping; designed either as one piece to seal by sliding into a groove in the sash or as two pieces that interlock; and completely concealed when window is closed.

2.8 MISCELLANEOUS MATERIALS

A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage by decay fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.

B. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.
2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

C. Adhesives: Wood adhesives for exterior exposure, with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.
3. Use concealed fasteners for attaching items to other work unless exposed fasteners are [**unavoidable**] [**or**] [**the existing fastening method**].
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

E. Anchors, Clips, and Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

2.9 WOOD WINDOW FINISHES

A. Shop-Finished Units: Alkyd finish system consisting of primer and two finish coats on exposed exterior and interior wood surfaces.

1. Color and Gloss: As selected by Architect.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean wood windows of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

3.2 HISTORIC TREATMENT OF WOOD WINDOWS, GENERAL

A. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood windows to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove coatings and apply borate preservative treatment before repair. Remove coatings according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
3. Repair items in place where possible.
4. Install temporary protective measures to protect wood window work that is indicated to be completed later.
5. Refinish historic wood windows according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as approved by Architect.

C. Repair and Refinish Existing Hardware: Dismantle window hardware; strip paint, repair, and refinish it to match finish samples; and lubricate moving parts just enough to function smoothly.

D. Repair Wood Windows: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair wood windows by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Where indicated, repair wood windows by limited replacement matching existing material.

E. Replace Wood Units: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

F. Protection of Openings: Where sash or windows are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.

G. Identify removed windows, frames, sash, and members with numbering system corresponding to window locations to ensure reinstallation in same location.

3.3 WOOD WINDOW PATCH-TYPE REPAIR

A. General: Patch wood members that exhibit depressions, holes, or similar voids, and that have limited amounts of rotted or decayed wood.

1. Treat wood members with wood consolidant before applying patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and unable to absorb more. Allow treatment to harden before filling void with patching compound.
2. Remove rotted or decayed wood down to sound wood.

B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.

C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD WINDOW MEMBER-REPLACEMENT REPAIR

A. General: Replace parts of or entire wood window members at locations where damage is too extensive to patch.

1. Remove broken, rotted, and decayed wood down to sound wood.
2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Repair remaining depressions, holes, or similar voids with patch-type repairs.

D. Glazing: Reglaze units before reinstallation.

E. Reinstall units removed for repair into original openings.

F. Weather Stripping: Replace nonfunctioning and install missing weather stripping to ensure full-perimeter and meeting rail weather stripping for each operable sash.

3.5 GLAZING

A. Comply with combined written instructions of manufacturers of glass, glazing systems, and glazing materials, unless more stringent requirements are indicated.

B. Remove cracked and damaged glass and glazing materials from openings and prepare surfaces for reglazing.

C. Remove glass and glazing from openings and prepare surfaces for reglazing.

D. Size glass as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances.

E. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.

F. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.

G. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.

H. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it unless otherwise indicated.

3.6 SHUTTER INSTALLATION

A. Install wood shutters at each window jamb indicated.

3.7 WEATHER STRIPPING INSTALLATION

A. Install weather stripping for tight seal of joints as determined by preconstruction testing and demonstrated in mockup.

END OF SECTION 08 03 52

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel frames.
2. Exterior standard steel doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include the following:

1. Elevations of each door 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.

C. 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.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Curries / Assa Abloy, or approved equal.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: 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 in accordance with NFPA 257 or UL 9.

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. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. Interior Door Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm).
b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Face welded.
d. Exposed Finish: Factory primed and prepared to receive painted finish on site.
e. Dimensions: As indicated in the Door and Frame Schedule on Drawings.

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. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.
1. Exterior Doors:

a. Elevation: As indicated in the Door and Frame Schedule on Drawings.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A60 (ZF180) 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: Manufacturer's standard.
i. Exposed Finish: Factory primed and prepared to receive painted finish on site.
j. Dimensions: As indicated in the Door and Frame Schedule on Drawings.

2. Thermally-Broken Exterior Door Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm).
b. Construction: Face welded
c. Exposed Finish: Factory primed and prepared to receive painted finish on site.
d. Dimensions: As indicated in the Door and Frame Schedule on Drawings.

C. Fabricate of steel sheet, minimum thickness of 0.053 inch (1.3 mm).

D. Construction: Face welded.

E. 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.

F. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.5 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 (610 mm) of frame height above 7 feet (2.1 m).

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

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 C665, 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 E136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 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 (19 mm) 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 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.
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.

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 in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.

1. Reinforce doors and frames to receive non-templated, 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 (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.8 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 ANSI/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 non-templated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Hollow-Metal Frames: Comply with ANSI/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 in accordance with NFPA 80.
3. Floor Anchors: Secure with post-installed expansion anchors.

a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
3. Smoke-Control Doors: Install doors in accordance with NFPA 105.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. 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.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

D. 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 REPAIR

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. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core flush wood doors with plastic-laminate-faces.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door frame construction.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.

C. Samples: For plastic-laminate door faces.

PART 2 - PRODUCTS

2.1 SOLID-CORE FLUSH WOOD DOORS WITH PLASTIC-LAMINATE FACES

A. Interior Doors, Solid Core with Plastic-Laminate Faces:

1. Basis of Design: Masonite; Aspiro
2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
3. Performance Grade by Location:

a. ANSI/WDMA I.S. 1A Extra Heavy Duty: Where indicated on Drawings.

4. Architectural Woodwork Standards Grade: Premium**.**
5. Plastic-Laminate Faces: High-pressure decorative laminates complying with ISO 4586-3, Grade HSH.
6. Colors, Patterns, and Finishes: As indicated.

7. Exposed Vertical and Top Edges: Plastic laminate that matches faces, applied before faces.

    a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.

        1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

8. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

    a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.

9. Construction:

    a. Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before faces and crossbands are applied.

2.2 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.

1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).
2. Anchor frames to anchors or blocking built in or directly attached to substrates.

    a. Secure with countersunk, concealed fasteners and blind nailing.
    b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

        1) For factory-finished items, use filler matching finish of items being installed.

3. Install fire-rated doors and frames in accordance with NFPA 80.
4. Install smoke- and draft-control doors in accordance with NFPA 105.

D. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

    a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

    a. Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
    b. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    c. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
    d. Comply with NFPA 80 for fire-rated doors.

5. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

3.2 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16

SECTION 08 14 33 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior stile and rail wood doors.
2. Interior fire-rated stile and rail wood doors.
3. Fire-rated wood door frames.
4. Factory priming.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Details of construction.
2. Door frame construction.
3. Factory-priming specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data, including those for stiles, rails, panels, and moldings (sticking); and other pertinent data, including the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimensions and location of hardware, lite locations, and glazing thickness.
3. Details of frame for each frame type, including dimensions and profile.
4. Clearances and undercuts.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.

1.4 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

B. 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. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies must 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door and Frame Assemblies: Complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

2.2 MATERIALS

A. Use only materials that comply with referenced standards and other requirements specified.

1. Assemble exterior doors, including components, with wet-use adhesives complying with ASTM D5572 for finger joints and with ASTM D5751 for joints other than finger joints.
2. Assemble interior doors, including components, with either dry-use or wet-use adhesives complying with ASTM D5572 for finger joints and with ASTM D5751 for joints other than finger joints.

B. Panel Products: Any of the following unless otherwise indicated:

1. Particleboard: ANSI A208.1, Grade M-2.
2. Medium-density fiberboard (MDF), complying with ANSI A208.2, Grade 130.
3. Hardboard complying with ANSI A135.4.
4. Veneer-core plywood.

2.3 INTERIOR STILE AND RAIL WOOD DOORS

A. Interior Stile and Rail Wood Doors: Interior stock doors complying with AWI, Architectural Woodwork Standards and with other requirements specified.

1. Basis of Design: VT Industries, Inc.
2. Performance Grade:

a. WDMA I.S. 6A: Heavy Duty.
b. Architectural Woodwork Standards: Custom.

3. Panel Designs: Indicated on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
4. Finish: Opaque.
5. Wood Species and Cut for Transparent Finish: Idaho white, lodgepole, ponderosa, or sugar pine, plain sawed/sliced.
6. Door Construction for Opaque Finish:

    a. Stile and Rail Construction:

        1) Clear softwood; may be edge glued for width and finger jointed.
        2) Veneered, structural composite lumber or veneered edge- and end-glued lumber.

    b. Raised-Panel Construction: Clear softwood lumber; edge glued for width.

7. Stile and Rail Widths: Manufacturer's standard, but not less than the following:

    a. Stiles, Top and Intermediate Rails: 4-1/2 inches (114 mm).
    b. Bottom Rails: 9 inches (229 mm).

8. Raised-Panel Thickness: 1-3/4 inches (44 mm).
9. Molding Profile (Sticking): As selected by Architect from manufacturer's full range.

2.4 INTERIOR FIRE-RATED STILE AND RAIL WOOD DOORS

A. 20-Minute, Interior Fire-Rated Stile and Rail Wood Doors: Fire-rated (20-minute rating) doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards and with other requirements specified.

1. Basis of Design:VT Industries, Inc.
2. Performance Grade:

    a. WDMA I.S. 6A: Standard Duty.

3. Panel Designs: Indicated on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
4. Finish: Opaque.
5. Door Construction for Opaque Finish: 1-3/4-inch- (44-mm-) thick stiles and rails and veneered flat panels not less than 5/8 inch (16 mm) thick, raised panels not less than 1-1/8 inches (29 mm) thick.

    a. Stile and Rail Construction: Veneered, structural composite lumber.
    b. Raised-Panel Construction: Shaped medium-density fiberboard (MDF.)
    c. Flat-Panel Construction: Veneered, wood-based panel product.
    d. Edge Construction for Fire-Rated Pairs of Doors:

        1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with

concealed intumescent seals. Comply with specified requirements for exposed edges.

6. Stile and Rail Widths: Manufacturer's standard, but not less than the following:

   a. Stiles, Top and Intermediate Rails: 4-1/2 inches (114 mm).
   b. Bottom Rails: 9 inches (229 mm).

7. Molding Profile (Sticking): As selected by Architect from manufacturer's full range.

2.5 FIRE-RATED DOOR FRAMES

A. Interior Frames: Refer to Section 081213 – “Hollow Metal Frames”

2.6 STILE AND RAIL WOOD DOOR FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:

   1. Clearances:

      a. Provide 1/8 inch (3 mm) at heads, jambs, and between pairs of doors.
      b. Provide 1/2 inch (13 mm) from bottom of door to top of decorative floor finish or covering.
      c. Where threshold is shown on Drawings or scheduled, provide not more than 3/8 inch (10 mm) from bottom of door to top of threshold.
      d. Comply with NFPA 80 requirements for fire-rated doors.

   2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
   3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) on lock edge; trim stiles and rails only to extent permitted by labeling agency.

B. Fabricate stile and rail wood doors in sizes indicated for field fitting.

C. Factory machine doors for hardware that is not surface applied.

   1. Locate hardware to comply with DHI-WDHS-3.
   2. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
   3. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
   4. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2.7 FACTORY PRIMING

A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099123 "Interior Painting."

2.8 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Opaque Finish:

1. Architectural Woodwork Standards Grade: Premium.
2. Color: As selected by Architect from manufacturer's full range.
3. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated door frames in accordance with NFPA 80.

a. Install frames level, plumb, true, and straight.

1) Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).

b. Anchor frames 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 woodwork.

c. For shop-finished items, use filler matching finish of items being installed.

2. Install fire-rated doors in accordance with NFPA 80.
3. Install smoke- and draft-control doors in accordance with NFPA 105.

C. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

    a. Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
    b. Provide 1/2 inch (13 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    c. Where threshold is shown on Drawings or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
    d. Comply with NFPA 80 for fire-rated doors.

5. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
6. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) on lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.2 FIELD QUALITY CONTROL

A. Inspections:

1. Provide inspection of installed Work through AWI's Quality Certification Program, certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door installations comply with specified requirements.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

END OF SECTION 08 14 33

SECTION 08 42 13 - ALUMINUM-FRAMED ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed entrance door systems.

1.2 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings:

1. Plans, elevations, sections, full-size details, and attachments to other work.
2. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. 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.

1.3 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Entity that employs installers and supervisors who are trained and approved by manufacturer.
2. Authorized representative who is trained and approved by manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of aluminum-framed entrances that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrance door systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at 150 percent of positive and negative wind-load design pressures, entrance doors, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
2. Test Durations: As required by design wind velocity, but not less than 10 seconds.

C. 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 of 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 6.24 lbf/sq. ft. (300 Pa).

D. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Entrance Doors: U-factor of not more than 0.68 Btu/sq. ft. x h x deg F (3.86 W/sq. m x K) as determined in accordance with NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

a. Entrance Doors: SHGC of not more than 0.27 as determined in accordance with NFRC 200.

3. Air Leakage:

a. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 ALUMINUM-FRAMED ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-mm-) 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: Medium stile; 3-1/2-inch (89-mm) nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

4. Door Finish: Clear anodic finish.

B. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.

1. Nominal Size: 6” deep with 2” sightline.
2. Exterior Framing Construction: Thermally broken.
3. Finish: Match door finish.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

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.

2. Steel Reinforcement:

a. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
b. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
c. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

3. 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.

2.3 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
2. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion.

C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Pivot Hinges: BHMA A156.4, Grade 1.

1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

E. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

F. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.

G. Cylinders:

1. As specified in Section 087100 "Door Hardware."

2. BHMA A156.5, Grade 1.

a. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" and notation to be furnished by Owner.

H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

I. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

J. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.

K. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

L. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

M. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

N. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

2.4 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.

2.5 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. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

F. 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.

G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOOR SYSTEMS

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. 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 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.

K. 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 according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

L. Install glazing as specified in Section 088000 "Glazing."

3.2 FIELD QUALITY CONTROL

A. Tests: Perform the following test on aluminum-framed entrance door systems.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect to be tested in accordance with AAMA 501.2 and to not evidence water penetration.

B. 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 "Inspection of Door Openings."

C. Aluminum-framed entrance door systems will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 08 42 13

SECTION 08 52 00 - WOOD WINDOWS

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 aluminum-clad wood windows.

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 wood 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 weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. 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 for wood windows.

B. Shop Drawings: For wood windows.

1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.

D. Samples for Initial Selection: For units with factory-applied finishes.

1. Include Samples of hardware and accessories involving color selection.

E. Samples for Verification: For wood windows and components required, prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
2. Exposed Hardware: Full-size units.

F. Product Schedule: For wood windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each type of wood window, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to wood window manufacturer for installation of units required for this Project.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood 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:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.
c. Aluminum-Cladding Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wood windows from single source from single manufacturer.

2.2 WINDOW 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: 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 Class: CW.
2. Minimum Performance Grade: 30.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.58.

E. Sound Transmission Class (STC): Rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.

F. Outside-Inside Transmission Class (OITC): Rated for not less than 26 OITC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E1332.

G. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone **1** for basic protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.3 WOOD WINDOWS

A. Aluminum-Clad Wood Windows: Basis of Design

1. Pella: Reserve Traditional, Putty Exterior Profile. Size as indicated on Drawings.

B. Operating Types: Provide the following operating types at locations indicated on Drawings:

1. Fixed.

C. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12

percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

1. Exterior Finish: Aluminum-clad wood.

    a. Aluminum Finish: Manufacturer's standard high-performance organic finish.
    b. Color: As selected by Architect from manufacturer's full range.

2. Interior Finish: Manufacturer's standard color-coated finish.
    a. Color: As selected by Architect from manufacturer's full range.

D. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

    a. Tint: Clear.
    b. Kind: Fully tempered where indicated on Drawings.

2. Lites: Two.
3. Filling: Fill space between glass lites with argon.
4. Low-E Coating.

2.4 ACCESSORIES

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.

1. Quantity and Type: Three per sash, two permanently located at exterior and interior lites and 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.

2.5 FABRICATION

A. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze wood windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

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.

2.6 TRIM

A. Provide extruded aluminum trim.

1. Profile: Match historic wood brickmould and sill.
2. Color: Match exterior finish of window unit.

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

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.

3.3 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. 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.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085200

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

   a. Swinging doors.

2. Cylinders for door hardware specified in all other Sections.
3. Electrified door hardware.

B. Related Requirements:

1. Section 08 11 13 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames.
2. Section 08 42 13 "Aluminum-Framed Entrances and Storefronts" for entrance door hardware.
3. Section 23 33 00 “Air Duct Accessories” for heating and air-conditioning duct access doors.

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, Owner's security consultant and Owner Lock Shop Manager.

CONTACT INFORMATION

- Bill Black
  Director Building Control Operations
  Property Management Division
  bill.black@maine.gov

- Gary Tibbetts
  Lock Shop Manager
  Property Management Division
  Gary.Tibbetts@maine.gov

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. 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.

C. 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.

D. 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.

E. Keying Schedules: Keying shall be performed by Owner

1.5 INFORMATIONAL SUBMITTALS

A. 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.

B. 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.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. 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.

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

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 ELECTRIFED 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

2.8 POWER DOOR OPERATOR (LOW ENERGY)

A. General:

1. Shall be integrated with Access Control System on access controlled (Card Reader) 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-V20- 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 type rooms shall be fitted with Function d.

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

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.

B. Maximum Air Leakage: When tested in accordance with ASTM E283/E283M with tested pressure differential of 0.3 inch wg (75 Pa), as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.

2.18 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.19 FINISHES

A. Provide finishes complying with ANSI/BHMA A156.18, US32D Satin Stainless Steel.

2.20 LEVER DOOR HANDLES

a. Basis of Design: Schlage #17 Lever and Rose

2.21 DOOR PULL

a. Basis of Design: Kawneer 1” diameter HD Offset Pull (10”)

2.22 DOOR BOTTOM

a. Basis of Design: Pemko 209V Door Shoe

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.

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.

END OF SECTION 087100

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Glazing sealants.
4. Miscellaneous glazing materials.

1.2 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.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

C. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For glass.

B. Product test reports.

C. Sample warranties.

1.6 WARRANTY

A. 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 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

B. 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. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.2 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. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

C. Thickness: Where glass thickness is indicated, it is a minimum.

D. 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.

2.3 GLASS PRODUCTS

A. 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.

B. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.4 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: Manufacturer's standard spacer material and construction.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.5 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 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks:

1. Type recommended in writing by sealant or glass manufacturer.

C. 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.

D. Edge Blocks:

1. Type recommended in writing by sealant or glass manufacturer.

E. 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.

PART 3 - EXECUTION

3.1 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 (1270 mm).

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.

3.2 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.

3.3 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.

3.4 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 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.

3.5 MONOLITHIC GLASS SCHEDULE

A. Clear Glass Type: Fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

3.6 INSULATING-LAMINATED-GLASS SCHEDULE

A. Low-E-Coated, Tinted, Insulating Laminated Glass Type:

1. Basis-of-Design Product: Vitro; Solarban 70.
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Outdoor Lite: 6 mm.
4. Outdoor Lite: Tinted fully tempered float glass.
5. Tint Color: Opti-Gray.
6. Interspace Content: Argon.
7. Indoor Lite: Clear laminated glass with two plies of fully tempered float glass.
    a. Minimum Thickness of Each Glass Ply: 6 mm.
    b. Interlayer Thickness: 0.030 inch (0.76 mm).
8. Low-E Coating: Pyrolytic or sputtered on second or third surface.
9. Safety glazing required.

END OF SECTION 08 80 00

SECTION 09 03 20 - HISTORIC TREATMENT OF PLASTER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Repair of historic interior lime plaster.
2. Repair and replacement of interior gypsum plaster.

B. Related Requirements:

1. Section 01 35 91 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 09 03 91 "Historic Treatment of Plain Painting" for paint removal, surface preparation for refinishing, and refinishing of historic plaster surfaces.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 01 22 00 "Unit Prices."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of plaster.
2. Review methods and procedures related to historic treatment of plaster and fire protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Mockups: Prepare mockups of historic treatment processes for each type of plaster repair and reconstruction work to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Number and Size: Two wall surfaces of at least 50 sq. ft. (4.5 sq. m) or approximately 48 inches (1200 mm) in least dimension to represent surfaces and conditions for application

of each type of plaster repair and reconstruction under same conditions as the completed Work. Include at least the following:

a. Install 6 linear ft. (2 m) of cast-plaster molding, but not less than two cast units.
b. Repair 3 linear ft. (1 m) of plaster cracks.

PART 2 - PRODUCTS

2.1 LIME-PLASTER MATERIALS

A. Hydrated Lime: ASTM C206, Type S or Type N.

B. Lime Putty: Slaked hydrated lime or factory-prepared lime putty according to ASTM C1489.

C. Sand Aggregates: ASTM C897.

1. Finish-Coat Sand: Match size, texture, and gradation of existing sand as closely as possible. Blend several sands if necessary to achieve suitable match.

2.2 GYPSUM PLASTER MATERIALS

A. Gypsum Materials:

1. Lightweight Gypsum Ready-Mixed Plaster: ASTM C28/C28M, with mill-mixed perlite aggregate.
2. Gypsum Neat Plaster: ASTM C28/C28M for use with job-mixed aggregates.
3. Gypsum Wood-Fibered Plaster: ASTM C28/C28M.
4. High-Strength Gypsum Neat Plaster: ASTM C28/C28M; with a minimum, average, dry compressive strength of 2800 psi (19 MPa) per ASTM C472 for a mix of 100 lb (45 kg) of plaster and 2 cu. ft. (0.06 cu. m) of sand.
5. Gypsum Gaging Plaster. ASTM C28/C28M.
6. High-Strength Gypsum Gaging Plaster: ASTM C28/C28M; with a minimum, average, dry compressive strength of 5000 psi (34 MPa) per ASTM C472 for a neat mix.
7. Gypsum Ready-Mixed Finish Plaster: ASTM C28/C28M; manufacturer's standard, mill-mixed, gaged, interior finish.
8. Gypsum Keene's Cement: ASTM C61/C61M.

B. Hydrated Lime: ASTM C206, Type S or Type N.

C. Aggregates:

1. Aggregate for Base-Coat Plasters: ASTM C35, sand.

2. Aggregate for Float Finishes: ASTM C35, sand; graded per ASTM C842.

D. Bonding Compound: ASTM C631.

2.3 LATH

A. Wood Lath: 1/4 inch by 1-1/4 inch (6 mm by 32 mm) sound, straight-grained, wood strips.

2.4 TRIM ACCESSORIES

A. General: According to ASTM C1063 for lime plaster and ASTM C841 for gypsum plaster; coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Cornerite: Fabricated from expanded-metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coating.
2. Striplath: Fabricated from expanded-metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coating.

2.5 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fasteners for Attaching Lath to Substrates:

1. For Lime Plaster: ASTM C1063.
2. For Wood Lath: ASTM C841 requirements for wood-floor-runner or wood-furring fasteners unless otherwise indicated on Drawings.

C. Wire Ties: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF PLASTER, GENERAL

A. General: In treating historic plaster, disturb it as minimally as possible and as follows unless otherwise indicated:

1. Dismantle loose, damaged, or deteriorated plaster, lath, and support systems that cannot be repaired.
2. Verify that substrate surface conditions are suitable for repairs.
3. Provide lath, furring, and support systems for plaster included in the work of this Section.
4. Replace lost details in new, wet-applied and cast plaster that replicate existing or indicated plaster configurations.
5. Leave repaired plasterwork in proper condition for painting or applying other finishes as indicated.
6. Install temporary protective measures to protect historic surfaces that shall be treated later.

B. Illumination: Perform plastering work with adequate, uniform illumination that does not distort the flatness or curvature of surfaces.

3.2 PLASTER REMOVAL AND REPLACEMENT, GENERAL

A. Dismantle plaster that is damaged or deteriorated to the limits indicated. Carefully dismantle areas along straight edges that lie over supports, without damaging surrounding plasterwork.

B. Maintain lath and supporting members in an undamaged condition so far as practicable. Dismantle damaged lath and supports that cannot be repaired or resecured and replace with new work of same type.

C. Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.

D. Clean substrate surfaces to remove grease, waxes, oils, waterborne staining, debris, and other foreign matter and deposits that could impair bond with repair material.

E. Wet wood lath bases before plaster application. Keep substrate damp to the touch but without visible water droplets.

F. Wet remaining plaster abutting the replacement plaster before installing new plasterwork.

G. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

H. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

3.3 FLAT LIME-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster at locations indicated on Drawings.

B. Lime-Plaster Base Coats:

1. Scratch Coat: 1 part lime putty, 2-1/2 parts base-coat sand, and fiber. Add hair fiber to mix and evenly distribute it without clumps just before spreading.
2. Brown Coat: 1 part lime putty, 3 parts base-coat sand.

C. Lime-Plaster Finish Coats:

1. Finish-Coat Mix for Smooth-Float Finish: As required to match finish of design reference sample.

D. Lime-Plaster Finishes:

1. Provide smooth-float finish unless otherwise indicated. Apply in two layers totaling 1/8 inch (3 mm) thick.

E. Hairline cracking within the plaster or plaster separation at edge of a replacement is unacceptable. Completely dismantle such work and reinstall or repair as a crack repair.

3.4 REMOVING AND INSTALLING LATH AND ACCESSORIES

A. General: Dismantle existing plaster as necessary to expose deteriorated or rusted lath, wire ties, and support system, back to firm substrates and supports. Repair with new materials, well secured to existing lath in good condition and to building structure.

1. Cutting: Cut lath so it can be taken out completely from one support to the next. Cut to avoid cracking surrounding plaster.
2. Cut out existing base-coat plaster beyond the edges of the new lath to permit new plaster to extend onto the old lath. Then step subsequent plaster coats to permit new plaster to extend over the old material.
3. Fasten new lath to support system and to good existing lath. Wire tie at least every 6 inches (150 mm).
4. Install new lath according to ASTM C1063 for lime plaster.

B. Wood Lath: Install wood lath in same orientation and spacing as remaining wood lath and with lath ends supported by furring or framing. Stagger ends of adjacent laths over different supports, not aligned, and secure with fasteners at each end and spaced a maximum of 24 inches (610 mm) o.c. into supports.

3.5 PATCH-TYPE REPAIR

A. General: Patch voids, fractured surfaces, and crushed areas in otherwise sound plaster that are larger than cracks.

1. Inspect for deterioration of supporting plaster and lath, and repair or replace deteriorated material as required for a sound substrate.
2. Rake perimeter of hole to sound plaster, and slightly undercut existing plaster to enable replacement plaster to tuck behind existing plaster.
3. Replace missing lath in kind. Bridge gaps in wood lath with expanded-metal lath, overlapping wood by 6 inches (150 mm) and fastening them together.
4. Clean hole to remove loose materials and other foreign matter and deposits that could impair bond with repair material.
5. Wet substrate to damp condition, but without visible water droplets, then install patch material to original profiles.

B. Lime-Plaster Mix: Repair mix demonstrated in mockup.

C. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

D. Hairline cracking within the plaster or plaster separation at edge of a patch is unacceptable. Completely dismantle such work and reinstall or repair.

3.6 HAIRLINE CRACK REPAIR

A. General: Repair cracks 1/32 inch (1 mm) in width or narrower in otherwise sound plaster.

B. Existing Topcoat: Open crack in existing topcoat to at least 1/8 inch (3 mm) in width and check for broken fiber reinforcement in base coats.

C. Existing Base Coats: Do not open crack wider in existing base coats unless inspection or other indication shows that the fiber reinforcement has broken. Where inspections indicate failure of fiber reinforcement, proceed as for a large crack repair, but only for length of crack with broken fiber reinforcement.

D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material.

E. Wet substrate to damp condition, but without visible water droplets.

F. Force finish-coat plaster without aggregate into crack, filling crack to original plaster profile.

G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

3.7 LARGE CRACK REPAIR

A. General: Repair cracks over 1/32 inch (1 mm) in width in otherwise sound plaster.

B. Open crack to at least 1/8 inch (3 mm) in width and full depth with V-groove tool, and check for bond separation or lath deterioration.

C. Abrade side surfaces of crack and remove inner crack debris by gouging (keying) the inside area of the crack.

D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material.

E. Wet substrate to damp condition, but without visible water droplets.

F. Install finish-coat plaster to fill crack to original plaster profile.

G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

END OF SECTION 09 03 20

SECTION 09 21 16.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum board shaft wall assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

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 E119 by an independent testing agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As indicated on Drawings

B. Gypsum Shaftliner Board:

1. Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch (25.4 mm) thick, with double beveled long edges.

C. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

D. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

1. Depth: As indicated

E. 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.

2.3 AUXILIARY MATERIALS

A. 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.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

C. 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.

D. Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 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. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged.

D. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

E. 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.

F. Penetrations: Install supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

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G. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.

H. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

J. Remove and replace panels that are wet, moisture damaged, or mold damaged.

END OF SECTION 09 21 16.23

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

A. Framing Members, General: Comply with AISI S220 and ASTM C645, Section 10 for conditions indicated.

1. Steel Sheet Components: Comply with AISI S220 and ASTM C645, Section 10 requirements for metal unless otherwise indicated
2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.

a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

B. Studs and Track: AISI S220.

1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
2. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. 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.

D. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 1-1/2 inches (38 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

E. Hat-Shaped, Rigid Furring Channels:

1. Minimum Base-Steel Thickness: As indicated on Drawings.
2. Depth: 7/8 inch (22.2 mm).

2.2 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 one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
2. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 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.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLATION OF FRAMING SYSTEMS

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

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. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. 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.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 FIELD QUALITY CONTROL

A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.2 ACTION SUBMITTALS

A. Product data.

B. Samples: For each texture finish indicated on same backing indicated for Work.

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 in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

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.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.

2. Long Edges: Tapered.
3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

a. Cornerbead.
b. Reveal Molding: F-shaped with 1” reveal; exposed long flange receives tape and joint compound; Color: black.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

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. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

2. Fill Coat: For second coat, use setting-type, sandable topping compound.
3. Finish Coat: For third coat, use setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

C. Sound-Attenuation Blankets: ASTM C665, 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: As specified in Section 07 92 19 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) 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.

D. 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.

3.2 FINISHING OF GYPSUM BOARD

A. Prefill open joints, rounded or beveled edges, and damaged surface areas.

B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

C. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:

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 09 91 23 "Interior Painting."

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, and mold damaged.

END OF SECTION 09 29 00

SECTION 09 51 13 - 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.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

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: Class A in accordance with ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS

A. Basis of Design: Armstrong Ceiling Solutions; Ultima Beveled Tegular #1911

B. Acoustical Panel Standard: Manufacturer's standard panels in accordance with ASTM E1264.

C. Color: White.

D. Light Reflectance (LR): 0.88.

E. Ceiling Attenuation Class (CAC): 35

F. Noise Reduction Coefficient (NRC): 0.75.

G. Edge/Joint Detail: Beveled Tegular.

H. Thickness: 3/4 inch (19 mm).

I. Modular Size: 24 by 24 inches (610 by 610 mm).

2.3 METAL SUSPENSION SYSTEM

A. Basis of Design: Armstrong Ceiling Solutions; Suprafine XL 9/16”

B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M.

C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; pre-painted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted white.

2.4 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.

B. Hold-Down Clips: Manufacturer's standard hold-down.

C. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

PART 3 - EXECUTION

3.1 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.

B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION

A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.

B. 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. Do not use exposed fasteners, including pop rivets, on moldings and trim.
3. Install hold-down clips in areas indicated; space in accordance with panel manufacturer's written instructions unless otherwise indicated.

END OF SECTION 09 51 13

SECTION 095423 - LINEAR METAL CEILINGS

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 strip linear metal pans and suspension systems for ceilings.

B. Related Sections:

1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.

1.3 DEFINITIONS

A. LR: Light Reflectance coefficient.

B. NRC: Noise Reduction Coefficient.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Exterior linear metal ceilings shall withstand exterior exposure and the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling units; or permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressure of 20 lbf/sq. ft. (960 Pa) acting inward or outward.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. 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 (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Performance Data: For installed products indicated to comply with design loads and other criteria, include structural analysis and other analytical data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: For components with factory-applied color and other decorative finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of appropriate size.

1.6 INFORMATIONAL SUBMITTALS

A. 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. Linear pattern.
2. Joint pattern.
3. Ceiling suspension members.
4. Method of attaching hangers to building structure.
    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
6. Ceiling perimeter and penetrations through ceiling; trim and moldings.
7. Minimum Drawing Scale: 1/8 inch = 1 foot.

B. Evaluation Reports: For linear metal ceiling and components and anchor type.

C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Linear Metal Ceiling Components: Quantity of each pan, carrier, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

1.9 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory with the experience and capability to conduct the testing indicated.

NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. Source Limitations: Obtain each set of linear metal pans and suspension systems from one source with resources to provide products of consistent quality in appearance, physical properties, and performance.

C. Surface-Burning Characteristics: Complying with ASTM E 1264 for Class A materials, as determined by testing identical products according to ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

D. Preinstallation Conference: Conduct conference at Project site.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver linear metal pans, suspension system components, and accessories to Project site in original, unopened packages 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. Handle linear metal pans, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not install linear metal 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.

1.12 COORDINATION

A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 LINEAR METAL CEILING PANS

A. Provide Box linear metal panel ceiling system manufactured by CertainTeed Architectural; 5015 Oakbrook Parkway, Suite 100, Norcross, GA 30093. Tel: (800) 366-4327; or equal approved by architect.

B. Sheet Metal Characteristics: For metal components 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, roughness, stains, or discolorations.

C. Linear metal panel ceiling system rated for interior and exterior installations:
   1. Panel Profile Type: Box 4, roll formed, (.025” interior/exterior thick aluminum with square edges; 3 5/32” wide, 17/32” deep with 27/32” reveal to form a 4” module.
   2. Panel length: minimum 3' – maximum 16'
   3. Closure: Recessed Closure required for exterior applications.
      a. Finish: Black

D. Linear Suspension System:
   1. Carrier: Universal hat-shaped, .038" roll-formed aluminum section with hook-shaped tabs spaced to receive ceiling panels at 2" on-center and 27/32" apart. Support holes spaced 4" on-center. Finish: Factory-applied black enamel.
   2. Hanger Wire: 12 gage galvanized carbon steel hanger wire.
   3. Seismic/Wind Uplift Compression Struts: 1-1/2” (38 mm) deep, 16 Ga., cold-rolled steel “C” channels.

A. Panel Finish:

1. Powder Coat (decorated wood-look option); color to be selected by architect from standard range.

E. End Caps: Manufacturer's standard material; fabricated to fit and conceal exposed ends of pans.

F. Filler Strips: Manufacturer's standard material; fabricated to uninterruptedly close voids between pans.

G. Moldings and Trim: Provide manufacturer's standard moldings and trim for exposed members, and as indicated or required, for edges and penetrations of ceiling, around fixtures, at changes in ceiling height, and for other conditions; of same metal and finish as linear metal ceiling pans.

2.2 METAL SUSPENSION SYSTEMS

A. Linear Suspension System:

1. Carrier: Universal hat-shaped, .038" roll-formed aluminum section with hook-shaped tabs spaced to receive ceiling panels at 2" on-center and 27/32" apart. Support holes spaced 4" on-center. Finish: Factory-applied black enamel.

2. Hanger Wire: 12 gage galvanized carbon steel hanger wire.

3. Seismic/Wind Uplift Compression Struts: 1-1/2” (38 mm) deep, 16 Ga., cold-rolled steel “C” channels.

A. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:

   1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
   2. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635, Table 1, Direct Hung will be less than yield stress of wire, Delete hanger

B. Carriers: Factory finished.

1. Main Carriers: Aluminum, not less than 0.240-inch (6.0-mm) rolled sheet, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, complying with ASTM B 209 (ASTM B 209M).

C. Carrier Splices: Same metal, profile, and finish as indicated for carriers.

D. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers at regular intervals and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated; and factory finished with matte-black baked finish.

E. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

F. Hold-Down Clips: Manufacturer's standard hold-down clips spaced as standard with manufacturer.

G. Edge Moldings and Trim: Provide exposed members as indicated or required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.

2.3 ACCESSORIES

A. Access Panels: For access at locations indicated, provide door hinge assembly, retainer clip, and retainer bar, assembled with ceiling panels and carrier sections into access doors of required size, permitting upward or downward opening.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" 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 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.

2.5 ALUMINUM FINISHES

A. Mill Finish: AA-M10C10.

B. Lacquered Mill Finish: AA-M10C10R1x with manufacturer's standard clear, organic coating.

C. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

D. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which linear metal 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 linear metal ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of linear metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width or -length pans at borders, and comply with layout shown on reflected ceiling plans and Coordination Drawings.

3.3 INSTALLATION

A. General: Install acoustical metal pan ceilings, per manufacturers shop drawings provided, per manufacturer's written instructions and to comply with publications referenced below.

1. ClSCA “Ceiling Systems Handbook”
2. Standard for Ceiling Suspension System Installations - ASTM C 636
3. Standard for Ceiling Suspension Systems Requiring Seismic Restraint - ASTM E 580
4. IBC (International Building Code) Standard for Seismic Zone for local area

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, counter-splaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produce hanger spacings that interfere with location of hangers at spacing required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Utilize supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
4. Where used secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye

screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Space hangers not more than 48” on-center, along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 12” from ends of each member. Supply supporting calculations from licensed Structural Engineer verifying hanger spacing meets all requirements, when spacing exceeds those recommended.

6. Level grid to 1/8” in 10’ from specified elevation(s), square and true.

7. Adjust suspension system runners so they are square (within .5 degree from 90 degrees) and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

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 but without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pan. Method of edge trim attachment and design of edge trims to be approved by Architect.

1. Screw attach moldings to substrate at intervals not more than 18” on-center and not more than 6” from ends, leveling with ceding suspension system to a tolerance of 1/8” in 10’. Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim without prior written approval, or unless detailed otherwise.

E. Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

3.4 CLEANING

A. Clean exposed surfaces of linear metal ceilings, including trim and edge moldings after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, 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 and bent units.

END OF SECTION 095423

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoset-rubber base.
2. Rubber molding accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

A. Roppe; Simplicity PV4000

B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

C. Thickness: 0.25 inch (6.4 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Preformed.

H. Colors: As selected by Architect from Manufacture’s full range.

2.2 RUBBER MOLDING ACCESSORY

A. Description: Rubber carpet edge for glue-down applications and reducer strip for resilient floor covering.

B. Profile and Dimensions: As indicated.

C. Locations: Provide rubber molding accessories at transitions between flooring finishes, and in areas indicated on the Drawings.

D. Colors and Patterns: As selected by Architect from Manufacturer's full range.

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 resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 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 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

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.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 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. Preformed Corners: Install preformed corners before installing straight pieces.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. 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.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.

1. Apply one coat.

C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rubber floor tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and pattern specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

PART 2 - PRODUCTS

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.

2.2 RUBBER FLOOR TILE

A. Basis of Design: Roppe; Renew Rubber Tiles

B. Hardness: Manufacturer's standard hardness, measured using Shore, Type A durometer according to ASTM D2240.

C. Wearing Surface: Textured at Entry, Smooth at Restrooms.

D. Thickness: 0.125 inch (3.2 mm).

E. Size: 24 by 24 inches (610 by 610 mm).

F. Colors and Texture: As selected by Architect from manufacturer's full range for the following three types indicated on the drawings.
   1. Rubber Tile 1
   2. Rubber Tile 2
   3. Rubber Tile 3

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.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 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 5 or more than 9 pH.
   4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

      a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

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 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.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 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. 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.

H. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply one coat.

END OF SECTION 09 65 19

SECTION 09 68 13 - TILE CARPETING

1.1 SUMMARY

A. Section Includes:

1. Modular carpet tile.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For carpet tile installation, provide plans 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. Pattern type, location, and direction.
5. Type, color, and location of edge, transition, and other accessory strips.
6. Transition details to other flooring materials.

C. Samples: For each exposed product and for each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.7 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 Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE:

A. Basis of Design: “Suitable” Carpet Tile as manufactured by Bentley Mills.

B. Color: As selected by Architect from manufacturer's full range.

C. Pattern: Ashlar.

D. Fiber Content: 100 percent nylon 6, 6.

E. Pile Characteristic: Tufted Textured Loop pile.

F. Backing System: NexStep Cushion.

G. Size: 24 by 24 inches (610 by 610 mm).

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Wood Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

B. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

C. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.2 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's 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. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, and thresholds. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Install pattern parallel to walls and borders.

G. 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 096813

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Finish coatings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of topcoat product.

1.3 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sherwin-Williams Company (The).
2. Benjamin Moore & Co.
3. Pratt & Lambert.

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint 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.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS

A. Water-Based Bonding Primer: Pigmented, water-based-emulsion primer formulated for exterior use and to promote adhesion of subsequent specified coatings.

1. Basis of Design: Sherwin Williams; Exterior Latex Wood Primer

2.4 FINISH COATINGS

A. Exterior, High-Build Latex Paint: Water-based, high-build, pigmented, emulsion coating; high-solids content improves filling, uniformity, and film build on concrete masonry surfaces. Formulated for abrasion, mold, microbial, and wind-driven rain resistance and for use on exterior masonry, concrete masonry unit, and concrete surfaces.

1. Basis of Design: Sherwin Williams; Emerald Urethane Trim Enamel
2. Gloss and Sheen Level: Manufacturer's standard semi-gloss finish.
3. Minimum Solids Content: Manufacturer's standard percentage solids by volume.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.

B. 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 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.

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 specified in this Section.

D. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.
1. Brushes:
   a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal being treated.
   b. Wood Substrates: Do not use wire brushes.

E. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material. Do not use other methods except as indicated as part of the historic treatment program and as approved by Architect.

3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions.

B. 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.

3.4 CLEANING AND PROTECTION

A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. 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.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates:

1. Quick-Drying Enamel System:

   a. Prime Coat: Quick-drying, alkyd metal primer.
   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Quick-drying alkyd enamel, gloss.

B. Galvanized-Metal Substrates:

1. Latex System:

    a. Prime Coat: Water-based, galvanized-metal primer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Exterior latex paint, semigloss.

C. Dressed-Lumber Substrates: Trim.

1. Latex over Latex Primer System:

    a. Prime Coat: Exterior, latex wood primer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Exterior latex paint, semigloss.

END OF SECTION 09 91 13

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Water-based finish coatings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of topcoat product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sherwin-Williams Company (The).
2. Benjamin Moore & Co.
3. Pratt & Lambert.

2.2 PAINT PRODUCTS, GENERAL

A. 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.

B. Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS

A. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster,

concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

B. Interior Latex Primer for Wood: Waterborne-emulsion primer formulated for resistance to extractive bleeding, mold, and microbials; for hiding stains; and for use on interior wood subject to extractive bleeding.

2.4 WATER-BASED FINISH COATS

A. Interior, Latex, Institutional Low Odor/VOC, Flat: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas of occupied buildings where the odor and VOC levels of conventional latex products would preclude their use.

1. At interior gypsum ceiling surfaces.
2. Gloss and Sheen Level: Manufacturer's standard flat finish.

B. Interior, Latex, Institutional Low Odor/VOC, Eggshell: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.

1. At interior gypsum wall surfaces.
2. Gloss and Sheen Level: Manufacturer's standard eggshell finish.

C. Interior, Latex, Institutional Low Odor/VOC, Semigloss: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.

1. At interior wood trim surfaces.
2. Gloss Level: Manufacturer's standard semigloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

B. 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 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.

C. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 INSTALLATION

A. Apply paints according to manufacturer's written instructions.

B. 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.

3.4 CLEANING AND PROTECTION

A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. 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.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Institutional Low-Odor/VOC Latex System:

    a. Prime Coat: Water-based rust-inhibitive primer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior, latex, institutional low odor/VOC, satin.

B. Finish Carpentry: Wood trim and Doors.

1. Institutional Low-Odor/VOC Latex System:

    a. Prime Coat: Interior latex primer for wood.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior, latex, institutional low odor/VOC, semigloss.

C. Gypsum Board and Plaster Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, institutional low odor/VOC, eggshell.

END OF SECTION 09 91 23

SECTION 10 14 19 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimensional characters.

a. Cast dimensional characters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. 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.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs 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 DIMENSIONAL CHARACTERS

A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:

1. Basis of Design: Dimensional letters as manufactured by Steel Art in Norwood, MA 02062
2. Character Material: Cast aluminum.
3. Character Height: As indicated on drawings.
4. Character Depth: 1.5”.
5. Character Font: As selected by Architect from manufacturer’s full range.
6. Finishes: Clear anodized, or as selected by Architect from manufacturer’s full range of finishes.
7. Mounting: Concealed fasteners.

2.2 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, use fastener finish as recommended by manufacturer.

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.

2.3 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
2. 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.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
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 sign 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.

PART 3 - EXECUTION

3.1 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. Masonry 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.
    b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.

C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101419

SECTION 10 14 23.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. 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.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs 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. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

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: APCO; Elevate Modular Sign System

2. Mounting: Manufacturer's standard method for substrates indicated.

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.

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.
2. Sign Mounting Fasteners:

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.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
3. 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-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

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. 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. Masonry 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.
   b. Thin or Hollow Surfaces: Place sign 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 sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. 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 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.
4. 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 SIGN SCHEDULE

A. Daschlager House

1. (3) Directory Signs – 11” wide Elevate Windows Sign (Insert) with historic Daschlager House graphic at top band.
2. (1) Accessible Toilet Room Sign for Toilet 107.
3. (8) 8 1/2" wide Room Identity Signs.
4. (2) signs for basement mechanical access door.

END OF SECTION 10 14 23.16

SECTION 10 26 00 - WALL PANEL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall panel systems for wall protection and decoration

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of wall panel showing locations and extent.

1. Include plans, elevations, sections, and attachment details.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Material certificates.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Standard Warranty: Limited lifetime warranty against material and manufacturing defects.

PART 2 - PRODUCTS

2.1 WALL PANEL SYSTEMS

A. Wall panel systems for wall protection and decoration made of .040” rigid vinyl sheet factory bonded to fire rated particleboard; Particleboard shall have no added urea formaldehyde; Rigid

vinyl sheet shall be manufactured from chemical and stain impact modifiers, and with no added plasticizers.

1. Basis of Design: Inpro Corporation, Palladium Square Edge Panel System
2. Finish: As selected by Architect from the “Woodgrains” palette, or equivalent.
3. Panel Depth: 3/8”
4. Panel Size: As indicated on drawings
5. Fire Rating: NFPA Class A

2.2 ACCESSORIES

A. Aluminum Trim: 6063-T5 extruded aluminum with 3/8” reveal. Provide at horizontal and vertical transitions between adjacent wall panels, and adjacent materials.

B. 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.

C. Adhesive: As recommended by protection product manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions in which wall panels will be installed.
   1. Complete all finishing operations, including painting, before beginning installation of panels.

B. Wall surface shall be dry and free from dirt, grease, and loose paint.

3.2 PREPARATION

A. Surface prep: Prior to installation, clean the substrate to remove dust, debris and loose particles. Ensure the substrate is sound and per project plans.

B. Acclimate product in temperatures between 65˚F and 80˚F and a humidity level less than 80% 24 hours in advance of installation.

C. The area of installation must be temperature and humidity controlled for a least 48 hours after installation.

3.3 INSTALLATION

A. Installation Quality: Install wall panels 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 trim, fasteners, adhesive and other accessories required for a complete installation.

3.4 CLEANING

A. At completion of installation, clean surfaces in accordance with manufacturer's clean-up and maintenance instructions.

END OF SECTION 10 26 00

SECTION 10 28 00 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Under-lavatory guards.
3. Custodial accessories.

1.2 ACTION SUBMITTALS

A. Product data.

B. Samples: For each exposed product and for each finish specified, full size.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 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. 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 (1112 N) concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser TB-1:

1. Description: Impact #2519 Double-roll dispenser.
2. Mounting: Surface mounted.
3. Operation: Non-control delivery with standard spindle.
4. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
5. Material and Finish: Plastic in (Smoke) finish

B. Paper Towel (Folded) Dispenser TB-2:

1. Description: San Jamar Ultrafold dispenser T1700BK
2. Mounting: Surface mounted.
3. Capacity: 240 C-fold or 400 multifold towels.
4. Material and Finish: Plastic in (Black Pearl) finish

C. Waste Receptacle TB-3:

1. Mounting: Surface mounted.
2. Minimum Capacity: 6.5 Gallon.
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
4. Liner: Reusable vinyl liner.
5. Lockset: Tumbler type for waste receptacle.

D. Soap Dispenser TB-4:

1. Description: Spartan Lite'n Foamy Manual Dispenser 975700
2. Mounting: Vertically oriented, surface mounted.
3. Capacity: 34 fluid ounces.
4. Materials: Plastic in (black) finish

E. Grab Bar TB-5:

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

    a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.

3. OD: 1-1/2 inches (38 mm).
4. Configuration and Length: As indicated on Drawings.

F. Mirror Unit TB-6:

1. Frame: Stainless steel angle, 0.05 inch (1.3 mm) thick.

    a. Corners: Manufacturer's standard.

2. Size: As indicated on Drawings.
3. Shelf:

a. Type: Integral, welded.
b. Depth: 5 inches (127 mm).

4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

G. Sanitary Napkin Receptacle TB-7:

1. Description: Rubbermaid 6140
2. Mounting: Vertically oriented, surface mounted.
3. Materials: Plastic in (white) finish

2.3 UNDERLAVATORY GUARDS

A. Under-lavatory Guard TB-8:

1. 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.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.4 FABRICATION

A. 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

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.

END OF SECTION 10 28 00

SECTION 12 35 30 - MANUFACTURED CASEWORK

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 kitchen cabinets.

B. Related Requirements:
   1. Section 123661 "Simulated Stone Countertops."

1.3 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. Exposed Surfaces of Cabinets: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.

C. Semi-exposed Surfaces of Cabinets: Surfaces behind opaque doors or drawer fronts, including interior faces of doors, interiors and sides of drawers, and bottoms of wall cabinets.

D. Concealed Surfaces of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, ends of cabinets installed directly against and completely concealed by walls or other cabinets, and tops of wall cabinets and utility cabinets.

1.4 ACTION SUBMITTALS

A. Product Data, for the following:

   1. Cabinets.
   2. Cabinet hardware.

B. Shop Drawings: Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, and hardware.

C. Samples, for the following:

   1. Cabinet Finishes
   2. Cabinet hardware

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For casework.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer that is certified for chain of custody by an FSC-accredited certification body.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete and dry, and temporary HVAC system is operating and maintaining temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.

C. Field Measurements: Where casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.

1.8 COORDINATION

A. Coordinate layout and installation of blocking and reinforcement in partitions for support of casework.

PART 2 - PRODUCTS

2.1 CABINETS

A. Products: Subject to compliance with requirements, provide the following:

1. KraftMaid Cabinets, or approved equivalent
   a. Door Style: Shaker 8
   b. Material: Evercore
   c. Finish: As selected by Architect from standard finish options..

B. Quality Standard: Provide cabinets that comply with KCMA A161.1.

1. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semi-exposed location of each unit and showing compliance with the above standard.

C. Face Style: Partial overlay; door and drawer faces partially cover cabinet fronts.

D. Factory Finishing: Finish cabinets at factory. Defer only final touchup until after installation.

2.2 CABINET HARDWARE

A. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected by Architect from manufacturer's full range.

B. Pulls: Amerock “Essential’Z”, 6.7” (160mm) Center-To-Center, Finish: Satin Nickel. BP24017SN

C. Hinges: Concealed European-style, self-closing hinges, with slow – closing feature.

D. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or Type B05091.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.

B. Install cabinets without distortion so doors and drawers fit the openings, are aligned, and are uniformly spaced. Complete installation of hardware and accessories as indicated.

C. Install cabinets level and plumb to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).

D. Fasten cabinets to adjacent units and to backing.

1. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips.

3.3 ADJUSTING AND CLEANING

A. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

B. Clean casework on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 12 35 30

SECTION 12 36 61.16 - 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.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples: For each type of material exposed to view.

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: Wilsonart; Solid Surface
2. Colors and Patterns: As selected by Architect from manufacturers Price Group 5.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Configuration:

1. Front: Straight, slightly eased at top, 1 1/2-inch high.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops:

1. 1/2-inch- (12.7-mm-) thick, solid surface material with front edge built up with same material.

D. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material.

E. Joints:

1. Fabricate countertops without joints.

F. 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.

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."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install countertops level to a tolerance of 1/8” inch in 8 feet (3mm in 2.4m)

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.

F. 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.

G. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 12 36 61.16

SECTION 12 48 13 - ENTRANCE FLOOR MATS AND FRAMES

1.1 SUMMARY

A. Section Includes:
   1. Resilient entrance mats.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

A. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 RESILIENT ENTRANCE MATS

A. Carpet-Type Mats: Basis of Design: Diagonal Tile as manufactured by MatsInc. of Stoughton MA.

   1. Colors: As selected by Architect from full range of available colors.
   2. Mat Size: 20” X 20”.
   3. Pattern: 90 degree rotation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install surface-type units to comply with manufacturer's written instructions; coordinate with entrance locations and traffic patterns.

END OF SECTION 124813

SECTION 14 24 00 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hydraulic passenger elevators.

1.2 ACTION SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing; machine room layout; coordination with building structure; relationships with other construction; and locations of equipment.
2. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as maximum and average power demands.

C. Samples: For finishes involving color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates: Signed by elevator manufacturer, certifying that hoistway, pit, and machine room layout and dimensions, as indicated on Drawings, and electrical service including standby-power generator, as indicated and specified, are adequate for elevator system being provided.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard five-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.5 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 10 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELEVATOR MANUFACTURERS

A. Basis of Design: TK Elevator; HMRL

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Standard: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

2.3 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components are used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:

1. Type:

a. Holeless, beside-the-car, telescoping, single cylinder.

2. Rated Load: 3500 lb (1589 kg).
3. Rated Speed: 100 fpm (0.51 m/s).
4. Operation System: Selective-collective automatic operation.
5. Auxiliary Operations:

a. Battery-powered lowering.
b. Automatic dispatching of loaded car.
c. Nuisance call cancel.
d. Loaded-car bypass.
e. Automatic operation of lights and ventilation fans.

6. Security Features: Card-reader operation.
7. Car Enclosures:

a. Inside Width: 80 inches (2032 mm) from side wall to side wall.

b. Inside Depth: 65 inches (1651 mm) from back wall to front wall (return panels).
c. Inside Height: Not less than 88 inches (2235 mm) to underside of ceiling.
d. Front Walls (Return Panels): Satin stainless steel, ASTM A480/A480M, No. 4 finish with integral car door frames.
e. Car Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
f. Side and Rear Wall Panels: Plastic laminate.
g. Door Faces (Interior): Satin stainless steel, ASTM A480/A480M, No. 4 finish.
h. Ceiling: Luminous ceiling.
i. Handrails: 1/2 by 2 inches (13 by 50 mm) rectangular satin stainless steel, at sides and rear of car.
j. Floor: As Indicated on Drawing A-C141

8. Hoistway Entrances:

a. Width: 42 inches (1067 mm).
b. Height: 84 inches (2134 mm).
c. Type: Single-speed side sliding.
d. Frames: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
e. Doors: Satin stainless steel, ASTM A480/A480M, No. 4 finish.

9. Hall Fixtures: Polished stainless steel, ASTM A480/A480M, No. 8 finish.
10. Additional Requirements:

a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from polished stainless steel, ASTM A480/A480M, No. 8 finish.
b. Provide hooks for protective pads in all cars and one complete set of full-height protective pads.

2.4 SYSTEMS AND COMPONENTS

A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.

1. Pump is submersible type with submersible squirrel-cage induction motor, and suspended inside oil tank from vibration isolation mounts or is tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and is mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
2. Motor has wye-delta or solid-state starting.
3. Motor has variable-voltage, variable-frequency control.

B. Hydraulic Silencers: System has hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.

C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.

1. Cylinder units are connected with dielectric couplings.

D. Hydraulic Fluid:

1. Hydraulic Fluid, Nontoxic and Biodegradable: Nontoxic, biodegradable, fire-resistant fluid, made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives, that is approved by elevator manufacturer for use with elevator equipment.

E. Guides: Roller guides, Polymer-coated, nonlubricated sliding guides, or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car frame.

2.5 OPERATION SYSTEMS

A. Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.

B. Auxiliary Operations:

1. Single-Car Standby-Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby. Manual operation causes automatic operation to cease.
2. Single-Car Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
3. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after 5 minutes and are re-energized before car doors open.

C. Security Features: Security features do not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at car-control stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide stripe-swipe card reader integral with car-control station at Daschlager House.

2.6 DOOR-REOPENING DEVICES

A. Infrared Array: Provide door-reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams causes doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door-reopening device, a loud buzzer sounds and doors begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

A. Provide steel-framed car enclosures with nonremovable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Enameled- or Powder-Coated-Steel Wall Panels: Flush, formed-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
2. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch (13-mm) manufacturer's standard honeycomb core with plastic-laminate panel backing and manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 or less, when tested according to ASTM E84. Plastic-laminate color, texture, and pattern as selected by Architect from elevator manufacturer's full range.
3. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet.
4. Sight Guards: Provide sight guards on car doors.
5. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
6. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
7. Metal Ceiling: Flush panels, with incandescent downlights in the center of each panel. Align ceiling panel joints with joints between wall panels.
8. Light Fixture Efficiency: Not less than 35 lumens/W.
9. Ventilation Fan Efficiency: Not less than 3.0 cfm/W (1.4 L/s per W).

2.8 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames are self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door-and-frame assemblies comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.

1. Fire-Protection Rating: 1 hour with 30-minute temperature rise of 450 deg F (250 deg C).

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Enameled- or Powder-Coated-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
2. Stainless Steel Frames: Formed from stainless steel sheet.
3. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet.
4. Sight Guards: Provide sight guards on doors matching door edges.
5. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.

6. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.9 SIGNAL EQUIPMENT

A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service.

E. Car Position Indicator: Provide digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

F. Hall Push-Button Stations: Provide hall push-button station at each landing as indicated.

G. Hall Lanterns: Units with illuminated arrows; however, provide single arrow at terminal landings. Provide one of the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

I. Standby-Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. At Nash School, adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.

J. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby-power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

K. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.

D. Stainless Steel Bars: ASTM A276/A276M, Type 304.

E. Stainless Steel Tubing: ASTM A554, Grade MT 304.

F. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063.

G. Plastic Laminate: High-pressure type complying with ISO 4586-3, Type HGS.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

B. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

C. Lubricate operating parts of systems as recommended by manufacturers.

D. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.

E. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

F. Locate hall signal equipment for elevators as follows unless otherwise indicated:

1. Place hall lanterns either above or beside each hoistway entrance.
2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

3.3 PROTECTION

A. Temporary Use: Comply with the following requirements for each elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
3. Engage elevator Installer to provide full maintenance service.
4. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

3.5 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes 24 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies are manufacturer's authorized replacement parts and supplies.

END OF SECTION 14 24 00

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and fittings.
2. Specialty valves.
3. Air vent.
4. Sprinkler piping specialties.
5. Sprinklers.
6. Alarm devices.
7. Pressure gauges.
8. Backflow Preventer
9. Alarm Bell
10. Exterior Electric Bell

B. Related Requirements:

1.2 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems in accordance with NFPA 13 Chapter 23.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated Design Submittals: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data, prepared by NICET Level III-certified technician, "Water-Based Systems Layout."

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler 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.

B. Qualification Data: For qualified Designer and NICET certified installing technician.

C. Design Data: Approved sprinkler piping working plans, prepared according to NFPA 13, including documented approval by authorities having jurisdiction, and including hydraulic calculations if applicable.

D. Welding certificates.

E. Field Test Reports:

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 in accordance with NFPA 291 within 6 months of submitting.

F. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

B. As-Built Drawings in accordance with NFPA 13.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. 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.

1.7 QUALITY ASSURANCE

A. Designer’s Qualifications:

1. Designers responsibilities include designing sprinkler 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 NICET Level III-certified technician, "Water-Based Systems Layout."

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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. Sprinkler system equipment, specialties, accessories, installation, and testing to comply with NFPA 13.

C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

D. Delegated Design: Engage a qualified NICET III`, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:
   a. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
   b. Elevator Machine Room and Hoistway: Ordinary Hazard, Group 1.
   c. General Storage Areas: Ordinary Hazard, Group 1.
   d. Libraries, except Large Stack Rooms: Light Hazard.
   e. Libraries, Large Stack Rooms: Ordinary Hazard, Group 2.
   f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
   g. Offices, including Data Processing: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design in accordance with NFPA 13.
4. Maximum protection area per sprinkler according to UL listing or manufacturers requirements, whichever is less.

E. Obtain documented approval of sprinkler system design from authorities having jurisdiction.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 40 Steel Pipe: Black-steel pipe, ASTM A135/A135M; ASTM A795/A795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 40. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Steel Pipe Nipples: Black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.

D. Steel Couplings: Steel, ASTM A865/A865M, threaded.

E. Gray-Iron Threaded Fittings: Uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

I. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.

1. 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.

J. Grooved-Joint, Steel-Pipe Appurtenances:
1. Pressure Rating: 175-psig minimum.
2. Grooved-End Fittings for Steel Piping: Painted grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
3. 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.

K. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

2.3 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Check Valves:
1. Standard: UL 193.
2. Design: For horizontal or vertical installation.
3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, and fill-line attachment with strainer.
4. Drip cup assembly pipe drain without valves and separate from main drain piping.
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.

G. Automatic (Ball Drip) Drain Valves:
1. Standard: UL 1726.
2. Pressure Rating: 175-psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

2.4 AIR VENT

A. Automatic Air Vent Assembly:
1. Description: Automatic dual air vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly.
2. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler system.
3. Vents oxygen continuously from system.
4. Float valve to prevent water discharge.
5. Minimum Water Working Pressure Rating: 175 psig.

2.5 SPRINKLER 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 Global's "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. Sprinkler Inspector's Test Fittings:
1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "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.

D. Flexible Sprinkler Hose Fittings:
1. Standard: UL 1474.
2. Type: 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.

2.6 SPRINKLERS

Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide.

A. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

B. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
2. 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.

C. Sprinkler Finishes: Chrome plated.

D. 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-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

E. Sprinkler Guards:
1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

2.7 ALARM DEVICES

A. Alarm-device types to match piping and equipment connections.

B. Electrically Operated Notification Appliances:
   1. Electric Bell:

      a. Standard: UL 464.
      b. Type: Vibrating, metal alarm bell.
      c. Size: 6-inch minimum- diameter.
      d. Voltage: 24 V dc.
      e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.

C. 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.

D. Valve Supervisory Switches:
   1. Standard: UL 346.
   2. Type: Electrically supervised.
   3. Components: Single-pole, double-throw switch with normally closed contacts.
   4. Design: Signals that controlled valve is in other than fully open position.
   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.

2.8 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.

D. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291 within 6 months of submitting calculations. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 331415 "Site Water Distribution Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping.

3.3 INSTALLATION OF 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 authorities having jurisdiction. 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 sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. 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 outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. 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.

M. Fill sprinkler system piping with water.

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Div 22.

O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Div 22.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

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 according to ASME B31.9.

G. 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.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "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 according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.5 INSTALLATION OF VALVES AND SPECIALTIES

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

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 check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

E. Air Vent:

1. Provide at least one air vent at high point in each wet-pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler 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.

3.6 INSTALLATION OF SPRINKLERS

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

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.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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 sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

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.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, 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 plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
3. 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.
4. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

D. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 and larger (DN 65 and larger), to be one of the Following:

1. Schedule 10 or 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 10 or 40, black-steel pipe with 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 roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4.
5. **Schedule 10 or 40**, black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright sprinklers Pendent, dry sprinklers Sidewall, dry sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION 211313

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and fittings.
2. Sprinklers.

1.2 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For dry-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated Design Submittals: For dry-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data, prepared by NICET Level III-certified technician, "Water-Based Systems Layout." NICET certified-technician submittals are to include the following information on each drawing title block: technician's name, NICET certification number, and NICET certification specialty area and level.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinate with all building trades.

1. Domestic water piping.
2. Compressed air piping.
3. HVAC hydronic piping.
4. Items penetrating finished ceiling including the following:

a. Lighting fixtures.

b. Air outlets and inlets.

B. Qualification Data: For qualified Installer and NICET certified technician.

C. Design Data: Approved sprinkler piping working plans, prepared according to NFPA 13, including documented approval by authorities having jurisdiction, and including hydraulic calculations if applicable.

D. Welding certificates.

E. Field Test Reports:

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.

F. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. 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.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler 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 NICET Level III-certified technician, "Water-Based Systems Layout."

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.8 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air or nitrogen. Opening of sprinklers releases compressed air or nitrogen and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

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. Sprinkler system equipment, specialties, accessories, installation, and testing to comply with NFPA 13.

C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

D. Delegated Design: Engage a qualified sprinkler designer with minimum NICET Level III to design dry-pipe sprinkler systems.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:
   a. As shown on fire protection plan sheets.

3. Minimum Density for Automatic-Sprinkler Piping Design:

   a. As shown on fire protection plan sheets.

4. Maximum protection area per sprinkler according to UL listing.

5. Maximum Protection Area per Sprinkler:

   a. According to NFPA 13 unless otherwise indicated .

6. Total Combined Hose-Stream Demand Requirement::

   a. According to NFPA 13 unless otherwise indicated.

E. Obtain documented approval of sprinkler system design from authorities having jurisdiction.

2.3 STEEL PIPE AND FITTINGS

A. Standard-Weight, Galvanized-Steel Pipe: ASTM A53/A53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 40, Galvanized-Steel Pipe: ASTM A135/A135M; ASTM A795/A795M, Type E ; or ASME B36.10M wrought steel. Pipe ends may be factory or field formed to match joining method.

C. Galvanized-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.

D. Galvanized-Steel Couplings: ASTM A865/A865M, threaded.

E. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME B16.1, Class 125.

H. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.

I. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Pressure Rating: 175-psig minimum.
   2. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
   3. 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.

2.4 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating for Residential Sprinklers: 175-psig maximum.

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. 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.

E. Sprinkler Finishes: Bronze or painted.

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-plated steel, one-piece, flat Chrome-plated steel, two piece, with 1-inch vertical adjustment.

G. Sprinkler Guards:
1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 INSTALLATION OF 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 authorities having jurisdiction. 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 sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

G. Drain dry-pipe sprinkler piping.

H. 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."

I. 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."

J. 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."

3.3 JOINT CONSTRUCTION

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. 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.

G. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

3.4 INSTALLATION OF SPRINKLERS

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers with water supply from heated space. Do not install pendent or sidewall sprinklers in areas subject to freezing.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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 sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 CLEANING

A. Clean dirt and debris from sprinklers.

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.

3.7 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:

1. Schedule 40, steel pipe with threaded ends; gray-iron threaded fittings; and threaded joints.
2. Schedule 40, steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.
3. Schedule 40, steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.8 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers

B. 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 not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211316

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide labor, materials, accessories, and other related items as required to complete operations in connection with the complete installation of the plumbing systems as indicated on the Drawings and as specified herein.

1.2 RELATED REQUIREMENTS

A. Conditions of the Contract apply to the work, including the work of this Division. Examine Contract Documents for requirements affecting the work.

B. Provide cooperation with, and assistance to, the Testing and Balancing (TAB) Agent specified in Division 23 Section “Testing, Adjusting, and Balancing for Mechanical Systems.”

1.3 PLUMBING PRE-CONSTRUCTION MEETING

A. Conduct a mechanical conference at Project site to comply with requirements of Division 01 Section “Project Management and Coordination” and the following:

1. At least 14 days prior to beginning of plumbing work, conduct a meeting to review detailed requirements for plumbing systems installation and testing requirements. Review plumbing Drawings and Specifications, discuss project specific details and requirements, and review and discuss expectations for quality control. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with plumbing systems installation to attend conference, including, but not limited to, the following:

    a. General Contractor's superintendent.
    b. Plumbing Subcontractor’s project managers.
    c. Plumbing Subcontractor’s job foreman.
    d. Mechanical Subcontractors’ project managers.
    e. Mechanical Subcontractors’ job foremen.
    f. Sheetmetal job foreman.
    g. Controls job foreman.
    h. Job clerk.
    i. Architect’s construction administrator.

1.4 DRAWINGS

A. The general location of the apparatus and the details of the work are indicated on the Drawings. Exact locations not indicated shall be determined at the site as the work progresses and shall be subject to the Architect's approval.

B. It is not intended that the Drawings shall show every pipe, pipe rise, pipe drop, pipe fitting, or appliance, but it shall be a requirement to furnish, without additional expense, material and

labor necessary to complete the systems in accordance with the design intent and with the highest possible quality available.

1.5 ALTERATIONS

A. Execute alterations, additions, removals, relocations, new work, and other related items as indicated or required to provide a complete installation in accordance with the intent of the Contract Documents, including changes required by building alterations.

B. Existing work disturbed or damaged by the alterations or the new work shall be repaired or replaced to the Architect's satisfaction and at no additional cost to the Owner.

C. Existing piping and other systems indicated to be removed, shall be removed from the site. Cap off existing services remaining. The Owner retains the right to ownership of plumbing equipment scheduled to be removed; store such equipment where requested by the Owner. Material not retained by the Owner shall be removed from the site.

1.6 CONTINUITY OF SERVICE

A. Arrange to execute the work at such times and in such locations as may be required to provide uninterrupted service for the building or any of its locations. Any unavoidable conditions requiring reduced building capacity shall be arranged for by programming with the Owner's duly authorized representative at the building subject to the Architect’s approval. If necessary, temporary work shall be installed to provide for the condition. Authorization for interrupting service shall be obtained in writing from the Owner. Any interruption of normal service shall be performed during an overtime period to be scheduled with the Owner. Costs for overtime work shall be included in the Bid.

1.7 REQUIREMENTS

A. Definitions: Unless otherwise specified, the following definitions shall apply to the work of this Division:

1. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
2. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
3. "Provide": Furnish and install, complete and ready for the intended use.
4. “Shall”: Indicates a mandatory requirement.

B. Installation Instructions: Obtain manufacturer’s printed installation instructions to aid in properly executing work on major pieces of equipment. Install equipment in accordance with manufacturer’s recommendations.

C. Objectionable Noise, Fumes and Vibration:

1. Plumbing and electrical equipment shall operate without creating objectionable noise, fumes, or vibration, as determined by the Architect.

2. If such objectionable noise, fumes, or vibration is produced and transmitted to occupied portions of building by apparatus, piping, or any other part of mechanical and electrical work, make necessary changes and additions, as approved, without extra cost to Owner.

D. Equipment Design and Installation:

1. Uniformity: Unless otherwise specified, equipment or material of same type or classification, used for same purposes, shall be product of same manufacturer.
2. Design: Equipment and accessories not specifically described or identified by manufacturer's catalog number shall be designed in conformity with ASME, IEEE, or other applicable technical standards, suitable for maximum working pressure, and with neat and finished appearance.
3. Installation: Erect equipment aligned, level and adjusted for satisfactory operation. Install so that connecting and disconnecting of piping and accessories can be made readily, and so that parts are easily accessible for inspection, operation, maintenance, and repair. Minor deviations from indicated arrangements may be made, as approved.

E. Hanging of Equipment and Piping:

1. Support equipment and piping from the top chord of bar joists at the “Panel Points” or from the top flange of beams. Piping 2-inch (50 mm) nominal and smaller may be supported from the bottom chord of the bar joists at the “Panel Points” or from the bottom flange of the beams.

F. Protection of Equipment and Materials: Responsibility for care and protection of materials and mechanical work rests with the Contractor until the entire project has been completed, tested and the project is accepted by the Owner.

G. Foundations:

1. Ceiling Mounting: Where ceiling mounting is indicated or specified, use suspended platform or strap hangers, bracket, or shelf, whichever is most suitable for equipment and its location. Construct of structural steel members, steel plates, or rods, as required; brace and fasten to building structure or to inserts as approved, or as detailed.
2. Where floor mounting is indicated, locate equipment on 4 inch (102 mm) high reinforced concrete pad of adequate size with anchors and base plates as required, on pressure-treated sleepers, or on structural steel frame as detailed. The corners of pads shall be chamfered 1 inch (25 mm). Pad and steel sizes and location shall be coordinated with the approved equipment.

1.8 ACCESS PANELS

A. Access panels required for items furnished under Division 22 shall be provided under this Division.

B. Manufacturer, and Model of standard doors: J. L. Industries, Inc., Model WB; Karp Associates, Inc., Model KDW; or The Williams Brothers Corporation of America, Model WB-DW.

C. Access panels shall be standard panels, 12 inch x 16 inch (305 mm x 406 mm) minimum unless indicated otherwise. Panels installed in areas of high moisture concentration, such as toilet

rooms, near plumbing fixtures, food preparation areas, or outdoors, shall be fabricated of paintable stainless steel or aluminum for corrosion resistance.

D. Doors and frames shall be factory primed. Latches shall be operated by tumbler lock, keyed alike, furnish 3 keys to the Owner.

E. Access panels in fire-rated construction shall have the same UL rating as the building assembly in which they are installed.

F. Provide access panels in building construction where required for access to components such as valves, air vents, drains, actuators, and other related items.

1.9 ELECTRIC WORK

A. Provide motors, pilot lights, controllers, limit switches, and other related items for equipment provided under Division 22.

B. Except as noted, required line switches, fused switches, and other related items and necessary wiring to properly connect equipment to motors and switches shall be furnished and installed under Division 26, Electric.

C. Provide complete wiring system for automatic controls as specified under Section Division 23 Section “Instrumentation and Controls for Mechanical Systems.”

D. Wiring shall conform to the requirements of the National Electrical Code.

1.10 FIRESTOPPING

A. Firestopping for penetrations of piping and equipment through fire rated and smoke rated building assemblies, including but not limited to partitions, walls, floors, ceilings, and roofs, shall be furnished and installed under this Section.

B. Selection of firestopping materials and installation of firestopping materials shall be in accordance with Division 07 Section “Through Penetration Firestop Systems.” Coordinate with other trades for a consistent installation.

C. Refer to Architectural Drawings for locations of fire rated building assemblies.

1.11 SUBMITTALS

A. After award of Contract and before installation, submit for approval Shop Drawings, bulletins, Product Data, Samples, and other related items.

B. Submit Shop Drawings and Product Data as required in each Section. Submittal shall include physical data and performance data required to verify compliance with the Contract Documents.

C. Submit Samples as required in each Section, and as indicated on the Drawings. These will generally be retained by the Architect/Engineer, unless otherwise indicated. Contractor may request these items returned; provide return shipping for returns.

D. Submit Mock-Ups as required in each Section, and as indicated on the Drawings. For general mock-up procedures, refer to Division 01 Section "Quality Requirements." Deliver to the Architect/Engineer for review if so indicated. Provide return shipping.

E. Submit Coordination Drawings in accordance with the Article "Coordination Drawings" in this Section.

F. Architect/Engineer's review will not include the review, coordination, or verification of dimensions or quantities; these shall be the responsibility of the Contractor.

1.12 SUBSTITUTIONS

A. Comply with provisions of the Instructions to Bidders and General Conditions.

B. The first item listed under "Acceptable Manufacturers," "Approved Manufacturers" or "Manufacturers" is the design basis.

1. Other manufacturers listed may be used in the Base Bid, but conformance with details of the Specifications, as well as dimensional and electrical data, shall be verified by the Contractor.
2. Architect/Engineer has not verified that each listed manufacturer has the ability to provide an acceptable substitution for the basis-of-design product. Contractor may not assume that substitutions will be approved.
3. Modifications required as a result of differences between the design basis item and the submitted and approved item must be approved by the Architect and made at the Contractor's expense. As an example, if a water storage tank is submitted and approved and if the unit's dimensions and weight are different from those of the unit which was used as the design basis, the Contractor shall be responsible for building structural modifications required to accommodate the submitted and approved unit, at no additional cost to the Owner.
4. When, in the Architect or Engineer's opinion, architectural or engineering services are necessary for the coordination of substituted items, the Contractor shall reimburse the Owner for the cost of these services.
5. For items which have no manufacturers listed, any item conforming with the Contract Documents is acceptable.

C. Substitutions from manufacturers or providers which are not listed may be proposed within the time allowed in the General Conditions of the Specifications.

1. The exception to this is products for which the list of manufacturers or providers is limited by the wording "no substitutions" or similar wording.

1.13 COORDINATION

A. Confirm and correlate dimensions and weights at the project site for tolerances, clearances, quantities, fabrication processes, and techniques of construction. Coordinate submittals with related building elements. Coordinate the Work with other trades, and verify full compliance with the Contract Documents. Comprehensive coordination and integration of submittals between trades is required and must be completed. Prevent schedule delays, and pay costs

resulting from changes and conflicts which have not been fully coordinated as part of the buy-out and submittal preparation.

B. Coordinate scheduling, submittals, and Work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Divisions having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements and installation of plumbing and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas, conceal pipes and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate Sections in preparation for Substantial Completion.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.14 COORDINATION DRAWINGS

A. Prepare Coordination Drawings in accordance to the requirements of this Specification. Before work progresses, create Coordination Drawings in AutoCAD (.dwg) electronic format. Deliver the Coordination Drawings to the General Contractor and each of their Subcontractors, in both electronic (.dwg) and printed (paper) format, for inclusion of their respective equipment and systems. Printed Coordination Drawings must include at least one set of reproducible at 3/8-inch per foot scale, and one set for scaling at 3/8-inch per foot scale. Prepare Coordination Drawings in accordance to the requirements of this Specification, and the following:

1. Indicate temporary relocation, phasing, sequencing, and moving of large equipment in the building during construction.

2. Provide floor plans and details, including the following:

a. Show piping, insulation, fixtures, pumps, isolation valves, trap primers, sensors, controllers, and the other equipment installed under this Division, showing the adjoining work of the other trades at each floor or enclosure level. Refer to Articles throughout this Section for additional coordination requirements.
b. Show piping including its insulation and fittings in plan views. Identify system types and flow directions, sizes, and insulation thicknesses.
c. Indicate system supports, supplemental framing, and blocking.
d. Note apparent conflicts, and suggest alternate solutions.

e. Show how systems will be installed where conflicts with the work of other trades may occur.
f. Show sizes, locations, and required clearances of access panels and doors.
g. Show wiring and conduit routing and sizing associated with the systems of this Division. Identify associated penetrations of building elements.
h. Prepare the Coordination Drawings to print in color, where that will enhance coordination and differentiation of systems. Bind supporting files with the AutoCAD files to ensure printing results are as intended.

B. Before submitting Coordination Drawings to the Owner for review, require other Subcontractors to revise the composite Coordination Drawings and submittals and to make reasonable modifications in the layout of their work, so that the Plumbing work may be properly accommodated without interference with work of other trades. Revise composite systems Coordination Drawings, when requested, without extra charge or schedule delay. For example, ductwork aspect ratio changes (including up to a 5 to 1 width to height ratio) must be considered reasonable changes and made with no time delay or cost to the Owner.

C. Pay the costs for changes in the Plumbing and adjoining work where an approved substitution of the Plumbing equipment requires such changes in the Plumbing work or in the adjoining work of any other trade. Provide Coordination Drawings showing the proposed changes at time of substitution transmittal.

D. Where installed systems will conflict with ceiling systems or the support thereof, coordinate the method of support and access for the ceiling. Plumbing systems must not be used to support the ceiling construction, and must not be placed in line with the ceiling's support points or interfere with raising of lay-in ceiling tiles and other items in the ceiling, unless written approval is obtained from the Architect of record for the specific areas of conflict.

E. Before transmittal of the Coordination Drawings to the Owner for approval, review with and obtain sign-off from each of the Subcontractors indicating that the work of their trade is fully coordinated.

1.15 REQUESTS FOR ARCHITECT'S CADD DRAWINGS

A. In lieu of generating their own CADD drawings, the Contractor may elect to use the Architect's electronic copies of CADD drawings for the purpose of developing coordination drawings, developing control system graphics or for other reasons that pertain to the requirements of this Contract. If the Contractor elects to utilize the Architect's electronic copies of CADD drawings, the electronic files shall be purchased from the Architect at the Architect's current billing rate per drawing. The Contractor shall provide payment and shall sign a release-of-liability form before electronic CADD drawings are released.

1.16 CLEANING

A. Remove debris from site daily.

B. Material and pieces of equipment shall be turned over to the Owner free of dust and dirt, both inside and out.

C. At the completion of the Project, equipment shall have a clean, neat appearance of factory finish by cleaning or repainting as required.

D. At the completion of the Project, surfaces exposed to view shall have a clean, neat appearance of finish free from smudges and scratches by cleaning or repainting as required.

1.17 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect/Engineer 7 days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of responsible manufacturer’s representative in accordance with manufacturer’s instructions.

G. When specified in individual Specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.18 ADJUSTMENTS AND OWNER'S INSTRUCTIONS

A. After completion of the installation work called for in the Contract Documents, furnish necessary mechanics or engineers for the adjustment and operation of the systems, to the end that the systems are perfectly adjusted and turned over to the Owner in perfect working order. Further instruct the Owner’s authorized representative in the care and operation of the installation, providing framed instruction charts, directions, and other related items.

B. Instructors providing Owner training shall be experienced and familiar with jobsite.

1.19 TESTING

A. After the entire installation is completed and ready for operation, test the systems as outlined in Division 23 Section “Testing, Adjusting and Balancing for Mechanical Systems.” These tests are supplementary to detailed tests specified herein or directed. The Owner will provide water and electric current for the test. Provide necessary labor, test pump, gauges, meters, other instruments, and materials. Perform tests in the presence of the Architect or his representative.

B. Perform other tests specified in individual Sections of this Specification.

1.20 COMPLETION OF SYSTEMS

A. The following plumbing systems shall not be complete until the following conditions are satisfied:

1. Piping Systems:

a. Piping, valves, and accessories shall be completely installed, insulated, and labeled as specified.
b. Piping pressure testing be completed and pressure testing reports shall be submitted and approved.
c. Piping systems shall be balanced and a balancing report shall be submitted and approved.

2. Equipment:

a. Equipment, including but not limited to plumbing fixtures, pumps, and water heaters, shall be completely installed.
b. Equipment start-up reports shall be completed, submitted, and approved.
c. Equipment balancing shall be completed and the balancing report shall be submitted and approved.

3. Automatic Controls:

a. Automatic controls shall be completely installed.
b. Controls shall operate in an automatic mode for a minimum of 2 months during Owner occupancy without substantial deficiencies.

1.21 OPERATING AND MAINTENANCE MANUALS

A. Furnish 2 bound operating and maintenance manuals and forward to the Architect for review and transmittal to the Owner.

B. For maintenance purposes, provide approved Submittals, parts lists, specifications, and manufacturer's maintenance bulletins for each piece of equipment. For materials used which have been submitted to the Architect for approval but do not require regular maintenance, such as piping and insulation, provide one copy of approved Submittals.

C. Provide name, address and telephone number of the manufacturer’s representative and service company, for each piece of equipment or material so that service or spare parts can be readily obtained.

1.22 WARRANTY

A. Provide guarantees and warranties for work under this Contract as indicated in the general requirements of the Contract.

B. Provide manufacturers’ standard warranties and guarantees for work by the plumbing trades. However, such warranties and guarantees shall be in addition to and not in lieu of other

liabilities which the manufacturer and the Plumbing Subcontractor may have by law or by other provisions of the Contract Documents.

C. Guarantee that elements of the systems provided under this Contract are of sufficient capacity to meet the specified performance requirements as set forth in these Specifications or as indicated on the Drawings.

D. Upon receipt of notice from the Owner of failure of any part of the plumbing systems or equipment during the warranty period, the Plumbing Subcontractor shall replace the affected part or parts.

E. Furnish a written guarantee covering the above requirements before submitting the application for final payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 220500

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.

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.

2.3 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 220513

SECTION 220517 - 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. Stack-sleeve fittings.
4. Sleeve-seal systems.
5. Grout.
6. Silicone sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. 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. Flexicraft.
2. Metraflex.

B. Description: Manufactured galvanized steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

2.3 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Jay R. Smith Mfg Co; a division of Morris Group International.
2. Wade; a subsidiary of McWane Inc.
3. Zurn Industries, LLC.

B. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.4 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, LLC.
2. CALPICO, Inc.
3. Garlock; a division of EnPRO Industries.
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 interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.5 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.

2.6 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.

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. Sherwin-Williams Company (The).
c. The Dow Chemical Company.
d. Tremco Incorporated.

2. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
3. Sealants may also be as specified in Division 07.

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. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. 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.

3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls.

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 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, seal the space around outside of sleeves.

3.3 INSTALLATION OF STACK-SLEEVE FITTINGS

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using waterproof silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.4 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.

3.5 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.

3.6 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 Partitions:

    a. Sleeves without waterstops.

END OF SECTION 220517

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.
2. Floor plates.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

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. Keeney Manufacturing Company (The).
4. McGuire Manufacturing.

2.2 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 brass with polished, chrome-plated finish and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

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.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping andRelocated Existing Piping: One-piece, floor plate.
2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. PVC ball valves.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. RPTFE: Reinforced polytetrafluoroethylene.

C. WOG: Water, oil, gas.

1.3 ACTION SUBMITTALS

1.4 Product Data: For each type of product 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.

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 B16.18 for cast copper solder-joint connections.
3. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
4. ASME B16.34 for flanged and threaded end connections
5. 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: Hand Lever.

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 BRASS BALL VALVES

A. Brass Ball Valves, Two Piece with Full Port and Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO Inc.

f. 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: Forged brass.
6. Ends: Threaded or soldered.
7. Seats: PTFE.
8. Stem: Brass.
9. Ball: Chrome-plated brass.
10. Port: Full.

B. Brass Ball Valves, Two Piece with Full Port and Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO Inc.
f. WATTS; A Watts Water Technologies Company.

2. Standard: MSS SP-110; MSS SP-145; IAPMO/ANSI Z1157.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Two piece.
5. Body Material: Forged brass.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Seats: PTFE or RPTFE.
9. Stem: Brass.
10. Ball: Chrome-plated brass.
11. Port: Full.
12. O-Ring Seal: Buna-N or EPDM.

C. Brass Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO Inc.
f. 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: Forged brass.
6. Ends: Threaded or soldered.
7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.

D. Brass Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Valve, Inc.
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    c. Hammond Valve.
    d. Milwaukee Valve Company.
    e. NIBCO Inc.
    f. WATTS; A Watts Water Technologies Company.

2. Standard: MSS SP-110; MSS SP-145; IAPMO/ANSI Z1157.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Two piece.
5. Body Material: Forged brass.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Seats: PTFE or RPTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Full.
12. O-Ring Seal: Buna-N or EPDM.

2.4 BRONZE BALL VALVES

A. Bronze Ball Valves, Two Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Hammond Valve.
    c. Milwaukee Valve Company.
    d. NIBCO Inc.
    e. 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: Bronze or brass.
9. Ball: Chrome-plated brass.
10. Port: Full.

B. Bronze Ball Valves, Two Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Hammond Valve.
    c. Milwaukee Valve Company.
    d. NIBCO Inc.
    e. WATTS; A Watts Water Technologies Company.

2. Standard: MSS SP-110; MSS SP-145; IAPMO/ANSI Z1157.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Seats: PTFE or RTPFE.
9. Stem: Bronze or brass.
10. Ball: Chrome-plated brass.
11. Port: Full.
12. O-Ring Seal: EPDM or Buna-N.

C. Bronze Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Hammond Valve.
    c. Milwaukee Valve Company.
    d. NIBCO Inc.
    e. 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.

2.5 PVC BALL VALVES

A. PVC Union 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. American Valve, Inc.
    b. Asahi/America.
    c. GF Piping Systems: Georg Fischer LLC.
    d. IPEX USA LLC.
    e. Jomar Valve.

2. Standard: MSS SP-122.
3. Pressure Rating and Temperature: 125 psig at 73 deg F.
4. Body Material: PVC.
5. Body Design: Union type.
6. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.
7. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable union with socket or threaded.
8. Ball: PVC; full port.
9. Seals: PTFE or EPDM-rubber O-rings.
10. Handle: Tee shaped.

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 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.

E. Install valves in position to allow full valve actuation movement.

F. Valve Tags: Comply with requirements in Section 220553 "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.

END OF SECTION 220523.12

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze, lift check valves.
2. Bronze, swing check valves.
3. Bronze, swing check valves, press ends.
4. PVC ball 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. Product Data: For each type of product.

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.

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 B16.18 for cast-copper solder joint.
3. ASME B16.22 for wrought copper solder joint.
4. ASME B16.51 for press joint.
5. 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 unacceptable.

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 Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE, LIFT CHECK VALVES

A. Bronze, Lift Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
c. Milwaukee Valve Company.
d. NIBCO INC.

e. WATTS; A Watts Water Technologies Company.

2. Standard: MSS SP-80, Type 1.
3. CWP Rating: 200 psig.
4. Body Design: Vertical flow.
5. Body Material: ASTM B61 or ASTM B62, bronze.
6. Ends: Threaded or soldered. See valve schedule articles.
7. Disc: Bronze.

B. Bronze, Lift 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. Milwaukee Valve Company.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company.

2. Standard: MSS SP-80, Type 2.
3. CWP Rating: 200 psig.
4. Body Design: Vertical flow.
5. Body Material: ASTM B61 or ASTM B62, bronze.
6. Ends: Threaded or soldered. See valve schedule articles.
7. Disc: NBR, PTFE.

2.4 BRONZE, SWING CHECK VALVES

A. Bronze, Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Milwaukee Valve Company.
c. NIBCO INC.

2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See valve schedule articles.
7. Disc: Bronze.

B. Bronze, Swing Check Valves with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Milwaukee Valve Company.
    c. NIBCO INC.

2. Standard: MSS SP-80, Type 4.
3. CWP Rating: 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See valve schedule articles.
7. Disc: PTFE.

C. Bronze, Swing Check Valves with Bronze Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Hammond Valve.
    c. Milwaukee Valve Company.
    d. NIBCO INC.

2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 300 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See valve schedule articles.
7. Disc: Bronze.

D. Bronze, Swing Check Valves, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Hammond Valve.
    c. Milwaukee Valve Company.
    d. NIBCO INC.

2. Standard: MSS SP-80 and MSS SP-139.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B584, bronze.
6. Ends: Press.
7. Press Ends Connection Rating: Minimum 200 psig
8. Disc: Brass or bronze.

2.5 PVC BALL 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. American Valve, Inc.
2. Asahi/America.
3. GF Piping Systems: Georg Fischer LLC.
4. IPEX USA LLC.
5. NIBCO INC.

B. Pressure Rating and Temperature: 125 psig at 73 deg F.

C. Body Material: PVC.

D. Body Design: Union-type ball check.

E. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, threaded.

F. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, threaded.

G. Ball: PVC.

H. Seals: EPDM- or FKM-rubber O-rings.

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. Examine press fittings to verify they have been properly pressed.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges 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.

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Check Valves: Center-guided type and plate type, in horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

I. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

J. 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 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 if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Circulating-Pump-Discharge Check Valves: Lift type, with spring-activated check.
2. Sump-Pump-Discharge Check Valves: Lift or swing type.
3. General Duty: Swing type.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

END OF SECTION 220523.14

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 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. Pipe-positioning systems.
7. Equipment supports.

B. Related Requirements:

1. Division 05 Specifications for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220500 "Common Work Results for Plumbing."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 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 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.

2.2 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.

2.3 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: Pregalvanized G90 or electroplated zinc.

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. Buckaroos, Inc.
2. CADDY; brand of nVent Electrical plc.
3. Carpenter & Paterson, Inc.

B. Insulation-Insert Material for Cold Piping: 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. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533 Type I calcium silicate with 100-psig, ASTM C552 Type II cellular glass with 100-psig, or ASTM C591 Type VI Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 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.

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. Hilti, Inc.
b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
c. MKT Fastening, LLC.

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. Manufacturers: 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 B-line; brand of Eaton, Electrical Sector.
b. Hilti, Inc.
c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
d. MKT Fastening, LLC.

2. Indoor Applications: Zinc-coated steel.
3. Outdoor Applications: Stainless steel.

2.6 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.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.8 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 MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from 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. Framing System Installation: Metal; arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

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. Pipe Stand Installation:

1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. 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.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. 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**] <**Insert size**> 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.

M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. 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.

O. 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. MSS SP-58, Type 39: Install 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. MSS SP-58, Type 40: Install 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 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
    b. NPS 4 (DN 100) and Larger: 12 inches long and 0.06 inch thick.
5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 INSTALLATION OF 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:

1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those 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 a minimum dry film thickness of 2.0 mils.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Division 09.

B. 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 finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use thermal hanger-shield inserts for insulated piping and tubing.

F. 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. 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.
3. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

G. 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 8.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 8 if longer ends are required for riser clamps.

H. 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.

I. 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. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. 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.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. 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.

K. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

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 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of equipment to be labeled, with the proposed content for each label.

D. Valve-numbering scheme.

E. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Craftmark Pipe Markers.
b. Kolbi Pipe Marker Co.
c. Pipemarker.com; Brimar Industries, Inc.
d. Seton Identification Products; a Brady Corporation company.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 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.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Craftmark Pipe Markers.
2. Kolbi Pipe Marker Co.
3. Pipemarker.com; Brimar Industries, Inc.
4. Seton Identification Products; a Brady Corporation company.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 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.

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 WARNING TAPE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Craftmark Pipe Markers.
3. Pipemarker.com; Brimar Industries, Inc.
4. Seton Identification Products; a Brady Corporation company.

B. Material: Vinyl.

C. Minimum Thickness: 0.005 inch.

D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.

E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.

F. Maximum Temperature: 160 deg F.

G. Minimum Width: 2 inches.

2.4 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Craftmark Pipe Markers.
3. Kolbi Pipe Marker Co.
4. Pipemarker.com; Brimar Industries, Inc.
5. Seton Identification Products; a Brady Corporation company.

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 partially cover 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:

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: Size letters in accordance with ASME A13.1 for piping.

2.5 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Craftmark Pipe Markers.
3. Kolbi Pipe Marker Co.
4. Pipemarker.com; Brimar Industries, Inc.
5. Seton Identification Products; a Brady Corporation company.

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 minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass link 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.

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 plumbing equipment.

B. Sign and Label Colors: White letters on an ANSI Z535.1 safety-color background.

C. Locate equipment labels where accessible and visible.

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 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.

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 Colors: White letters on an ANSI Z535.1 safety-color background.

3.6 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 or square.

2. Valve-Tag Colors: For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.7 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 necessary for safety.

END OF SECTION 220553

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. Indirect waste drainage piping.
5. Supplies and drains for handicap-accessible lavatories and sinks.
6. Sewage ejector pump basin sides.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. 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.

C. Field quality-control reports.

1.4 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. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging shall include name of the manufacturer, fabricator, type, description, and size.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "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.

1.7 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. Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. 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, provide products by one of 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.
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

F. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. 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. Owens Corning.

2. Preformed Pipe Insulation: Type II, Grade A with factory-applied ASJ.
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

G. Sewage Ejector Pump Basin Insulation, Flexible Elastomeric: Closed-cell or expanded EPDM or NBR rubber materials; suitable for use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armacell.
   b. K-Flex USA.

2.3 INSULATING CEMENTS

A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

C. Glass-Fiber and Mineral Wool 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armacell.
    b. K-Flex USA.
2. Flame-spread index 25 or less and smoke-developed index 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.
5. Color: Insert color.

C. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

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.
3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
4. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: 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 180 deg F.
3. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: Minus 50 to plus 220 deg F.

3. Color: White.

E. 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.
3. Color: White.

2.6 LAGGING ADHESIVES

A. Adhesives 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 pipe insulation.
2. Service Temperature Range: 20 to plus 180 deg F.
3. Color: White.

2.7 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.

C. FSK and Metal Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: Aluminum.

D. 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.

2.8 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.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. 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. Manufacturers: 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. Proto Corporation.
    c. Speedline Corporation.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. 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.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.11 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

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 Industrial Adhesives and Tapes Division.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., Inc., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. 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. Manufacturers: 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 Industrial Adhesives and Tapes Division.
    b. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A240/A240M, Type 304; 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. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

2.14 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers – For Kitchen Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Truebro; IPS Corporation – Lav Guard 2 product line.
   b. McGuire Manufacturing.
   c. Zurn Industries, LLC.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements. See Part 3 of this Section for installation requirements.

B. Protective Shielding Piping Enclosures – For Wall-Hung Lavatories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Truebro; IPS Corporation – Lav Shield product line.
   b. Sloan Valve Co.
   c. Zurn Industries, LLC.

2. Description: Manufactured plastic continuous one-piece enclosure for covering plumbing fixture hot- and cold-water supplies, trap and drain piping, and accessories. Comply with ADA requirements. See Part 3 of this Section for installation requirements.

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. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. 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.

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.

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 Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations 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.

D. 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.

E. 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 below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation 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 flanges, mechanical couplings, and 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, 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.

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 GLASS-FIBER AND MINERAL WOOL 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.

3.7 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.

3.8 INSTALLATION OF PROTECTIVE SHIELDING GUARDS

A. The U.S. Department of Justice 2010 ADA Standards for Accessible Design, chapter 606.5 Exposed Pipes and Surfaces requires configuring pipes under lavatories and sinks to protect against contact, and requires no sharp or abrasive surfaces in those locations.

B. For wall-hung lavatories, provide protective one-piece shielding piping enclosures to enclose piping and other components such as mixing valves and faucet controls. Provide rigid wall blocking behind the finished wall surface, anchors to the blocking, and removable-reusable hex-head stainless steel fasteners selected for ease of service.

C. For sinks, provide protective shielding pipe covers. For sinks which have Architectural enclosures that comply with ADA chapter 606.5, individual pipe covers may be omitted.

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket as specified in Division 09.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating. Allow to cure before applying protective jacket.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable insulation materials thicknesses are identified for each piping system and pipe size range.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. 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: 1/2 inch thick.
2. NPS 1-1/4 and Larger: 3/4 inch thick .

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: 1 inch thick.
2. NPS 1-1/2 inch and Larger: 1-1/2 inches thick.

C. Indirect Waste Drainage Piping: 3/4-inch thick.

D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. Protective shielding guards.

3.12 SEWAGE EJECTOR PUMP BASIN:

1. Sides: Elastomeric equipment insulation, 3/4 inches thick.

3.13 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. Provide jacket and fitting systems in occupied spaces, and in unoccupied spaces including but not limited to basements, storage rooms, utility rooms, and mechanical rooms.

C. Piping, Concealed: None.

D. Piping and Equipment, Exposed, 8 Feet or Less Above Floor: PVC, 30 mils thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. Piping joining materials - domestic water.
3. Dielectric fittings - domestic water.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service in accordance with requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, 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.

2.2 PIPING MATERIALS

A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

A. Drawn-Temper Copper Tube: ASTM B88, Type L.

B. Annealed-Temper Copper Tube: ASTM B88, Type K.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.

F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.

G. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.

H. Copper-Tube, Mechanically Formed Tee Fitting - Domestic Water: For forming T-branch on copper water tube.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. T-DRILL Industries Inc.

2. Description: Tee formed in copper tube in accordance with ASTM F2014.

I. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Mueller Streamline Co.; a company of Mueller Industries.
   c. NIBCO Inc.
   d. Viega LLC.

2. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.
3. Housing: Copper.
4. O-Rings and Pipe Stops: EPDM.
5. Tools: Manufacturer's special tools.
6. Minimum 200 psig working-pressure rating at 250 deg F.

2.4 PIPING JOINING MATERIALS - DOMESTIC WATER

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 DIELECTRIC FITTINGS - DOMESTIC WATER

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 - Domestic Water:

1. Source Limitations: Obtain dielectric unions from single manufacturer.
2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges - Domestic Water:

1. Source Limitations: Obtain dielectric flanges from single manufacturer.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits - Domestic Water:

1. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.
2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Phenolic, Temperature Rating: 225 deg F.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples - Domestic Water:

1. Source Limitations: Obtain dielectric nipples from single manufacturer.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller shall be the following:

1. Annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

E. Aboveground domestic water piping shall be one of the following:

1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.2 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 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 in accordance with CDA's "Copper Tube Handbook."

C. Install valves in accordance with the following:

1. Section 220523.12 "Ball Valves for Plumbing Piping."
2. Section 220523.14 "Check Valves for Plumbing Piping."

D. Install water-pressure-reducing valves with shutoff valves immediately upstream. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. 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.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

I. Install piping to permit valve servicing.

J. 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.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

N. Install pressure gauges on suction and discharge piping for each plumbing pump.

O. Install sleeves for piping penetrations of walls, ceilings, and floors.

P. Install sleeve seals for piping penetrations of concrete walls and slabs.

Q. Install escutcheons for piping penetrations of walls, partitions, ceilings, and floors.

3.3 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 pipes, tubes, and fittings before assembly.

C. 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.

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 in accordance with ASTM B828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

G. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts in accordance with ASME B31.9.

I. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for 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 piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 PIPING 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 water-service piping with shutoff valve; extend and connect to the following:

1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
2. 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 220553 "Identification for Plumbing Piping and Equipment."

3.8 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 in accordance with 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.

3.9 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 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.

3.10 FIELD QUALITY CONTROL

A. 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 installation 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. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. 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.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Strainers for domestic water piping.
5. Hose bibbs.
6. Wall hydrants.
7. Drain valves.
8. Water-hammer arresters.
9. Trap-seal primer devices (TP-1).

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. 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. WATTS; A Watts Water Technologies Company.

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.

B. Hose-Connection 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. Cash Acme Plumbing Products; an RWC brand.
    b. WATTS; A Watts Water Technologies Company.
    c. Woodford Manufacturing Company.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.

5. Finish: Rough bronze.

C. Pressure 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. WATTS; A Watts Water Technologies Company.
   c. Zurn Industries, LLC.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. WATTS; A Watts Water Technologies Company.
   c. Zurn Industries, LLC.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Body: Bronze or cast silicon copper alloy.
5. End Connections: Threaded.
6. Configuration: Designed for vertical flow.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Caleffi North America.
   c. Cash Acme Plumbing Products; an RWC brand.
   d. WATTS; A Watts Water Technologies Company.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.

4. Body: Bronze.
5. End Connections: Threaded.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze.
3. End Connections: Threaded.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size: 0.033 inch .
6. Drain: Pipe plug.

2.7 HOSE BIBBS

A. Hose Bibbs (HB-1):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. MIFAB, Inc.
    b. Nibco Inc.
    c. Prier Products, Inc.
    d. WATTS; A Watts Water Technologies Company.
    e. Woodford Manufacturing Company.
    f. Zurn Industries, LLC.

2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 3/4 threaded inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral,drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish: Chrome or nickel plated.
10. Operation: Metal wheel handle.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants (WH-1):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. MIFAB, Inc.
c. Woodford Manufacturing Company.
d. 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. Furnish two operating keys with each hydrant.
5. Casing and Operating Rod: Of length required to match wall thickness; with wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet, Exposed: With integral ASSE Standard 1052 approved field testable double-check backflow preventer, and garden-hose thread complying with ASME B1.20.7.
8. Nozzle and Wall-Plate Finish: Polished nickel bronze or chrome plated.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy, with threaded joints, replaceable seats and seals.
5. Ball: Chrome-plated brass.
6. Handle: Vinyl-covered steel.
7. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. MIFAB, Inc.
c. Precision Plumbing Products.
d. Sioux Chief Manufacturing Company, Inc.
e. WATTS; A Watts Water Technologies Company.
f. Zurn Industries, LLC.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or pPiston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.11 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device (TP-1):

1. Basis of Design Product: Precision Plumbing Products model PR-500 Prime-Rite.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. MIFAB, Inc.
c. Precision Plumbing Products.
d. Sioux Chief Manufacturing Company, Inc.

3. Standard: ASSE 1018.
4. Operating Pressures: Activate with 5 psig maximum pressure drop, over a range of inlet pressures including 30 to 125 psig.
5. Body: Lead-free brass, vacuum breaker ports, removable stainless steel mesh inlet screen.
6. Inlet and Outlet Connections: NPS 1/2 threaded; may include unions.
7. Distribution Unit: Same manufacturer as primer device. Brass or plastic body. NPS 1/2 threaded inlet, 1/2-inch union or threaded outlets. Plug unused outlets.

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. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with valve. Install pressure gauge on outlet.

C. Supply-Type, Trap-Seal Primer Device: Install with branch off top of fixture supply pipe to minimize debris entering the device. Provide inlet service valve, outlet distribution unit, and outlet piping pitched down at least 1 percent toward drain traps. Connect to waste receptors as detailed. Test valve for proper flow when fixture is activated.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Allow space for service and maintenance of specialties and other equipment.

3.3 IDENTIFICATION

A. At Trap-Seal Primers, per Section 220553 “Identification for Plumbing Piping and Equipment.”

3.4 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT 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. Copper tube and fittings.
4. PVC pipe and fittings.
5. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste 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 Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

1.5 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding 10 ft. head of water working pressure unless otherwise indicated.

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 and extra-heavy cast iron.

C. Gaskets: ASTM C564, rubber.

D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

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, provide products by one of the following:

    a. ANACO-Husky.
    b. Charlotte Pipe and Foundry Company.
    c. Fernco Inc.
    d. MIFAB, Inc.
    e. Mission Rubber Company, LLC; a division of MCP Industries.
    f. 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 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B88, Type L, water tube, drawn temper.

D. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

E. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.6 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. IPEX.
3. JM Eagle.

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.

F. Solvent Cement: ASTM D2564.

2.7 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

    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) Dallas Specialty & Mfg. Co.
        2) Fernco Inc.
        3) Mission Rubber Company, LLC; a division of MCP Industries.

    b. Standard: ASTM C1173.
    c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    d. End Connections: Same size as and compatible with pipes to be joined.
    e. Sleeve Materials:

        1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
        2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
        3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

    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) Cascade Waterworks Mfg. Co.
        2) Mission Rubber Company, LLC; a division of MCP Industries.

    b. Standard: ASTM C1460.
    c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    d. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

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 calculate friction loss, expansion, pump sizing, 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 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. Make changes in direction for soil and waste drainage and vent 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.

K. Install soil and waste and vent 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 Piping: One percent down toward vertical fixture vent or toward vent stack.

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."

1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.

M. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."

N. Install aboveground PVC piping in accordance with ASTM D2665.

O. Install underground PVC piping in accordance with ASTM D2321.

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 221319 "Sanitary Waste Piping Specialties."

2. Install drains in sanitary waste gravity-flow piping.

a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

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.

S. Install sleeve seals for piping penetrations of concrete walls and slabs.

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 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. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.

C. 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.

D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.

1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

    a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    c. Do not use pipe sections that have cracked or open welds.

E. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

F. 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. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

3.3 INSTALLATION OF SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Unshielded or shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

    a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
    b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

3.4 INSTALLATION OF VALVES

A. General valve installation requirements for general-duty valve installation are specified in the following Sections:

1. Section 220523.12 "Ball Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".

3.6 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 cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to sump pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections in accordance with 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.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 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.

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.

E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.

a. Isolate test source and allow to stand for four hours.
b. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent 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 Plastic Piping: Protect PVC plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping shall be 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.
3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, indirect waste piping shall be one of the following:

1. Hubless, cast-iron soil pipe and fittings;heavy-duty hubless-piping couplings; and coupled joints.
2. Copper Type DWV tube, copper drainage fittings, and soldered joints.

D. Aboveground, indoor vent piping shall be the following:

1. Service cast iron, 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.
3. Copper Type DWV tube, copper drainage fittings, and soldered joints.

    a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2 (DN 65 and DN 90): Hard copper tube, Type M; copper pressure fittings; and soldered joints.

4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Aboveground, outdoor (such as through and above roof) vent piping shall be the following:

1. Service cast iron, 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.

F. Underground, soil, waste, and vent piping shall be the following:

1. Cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

G. Aboveground sanitary-sewage force mains shall be one of the following:

1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

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. Air-admittance valves.
3. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
2. Section 077200 "Roof Accessories" for preformed flashings.
3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.

1.3 DEFINITIONS

A. ABS: Acrylonitrile butadiene styrene.

B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
   e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. 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.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
   e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.

3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Spigot.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze copper alloy, or Stainless steel.
11. Frame and Cover Shape: Round.
12. Top-Loading Classification: MediumDuty.
13. Riser: ASTM A74, ServiceClass, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
    e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch, or hubless, cast-iron soil pipe test tee, as required to match connected piping.
5. Closure Plug:

    a. Brass.
    b. Countersunk or raised head.
    c. Drilled and threaded for cover attachment screw.
    d. Size: Same as or not more than one size smaller than cleanout size.

6. Wall Access, Cover Plate: Round, deep, chrome-plated bronze; or flat, chrome-plated brass or stainless steel cover plate with screw.
7. Wall Access, Frame and Cover: Square, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

2.3 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Oatey Co.
    b. ProVent Systems.

c. Studor, Inc.

2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance 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. Oatey Co.
b. Sioux Chief Manufacturing Company, Inc.
c. Studor, Inc.

2. Standard: ASSE 1050 for vent stacks.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected stack vent or vent stack.

C. Wall Box for Air-Admittance 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. Oatey Co.
b. Sioux Chief Manufacturing Company, Inc.
c. Studor, Inc.

2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: Approximately 6 inches wide by 6 inches high by 4 inches deep.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. 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.

C. 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.

D. Floor-Drain, Inline Trap Seal:

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. Green Drain, Inc.
    b. Jay R. Smith Mfg Co; a division of Morris Group International.
    c. Josam Company.
    d. MIFAB, Inc.
    e. RectorSeal Plumbing; A CSW Industrials Company.

2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: ICC-ES or IAPMO listed.
6. Size: Same as floor drain outlet or strainer throat.

E. 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.

F. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

G. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

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 fixture air-admittance valves on fixture drain piping.

E. Install stack air-admittance valves at top of stack vent and vent stack piping.

F. Install air-admittance-valve wall boxes recessed in wall.

G. Assemble open drain fittings and install with top of hub 2 inches above floor.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. 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.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

L. Install wood-blocking reinforcement for wall-mounting-type specialties.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

A. Comply with requirements in Section 221316 "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 LABELING AND IDENTIFYING

A. 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.

1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 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 221319

SECTION 221329 - SANITARY SEWERAGE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged, submersible sewage-pump units.

B. Related Requirements:

1. Section 221429 "Sump Pumps" for applications in storm-drainage systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.4 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 manufacturer's written instructions for handling.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

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: Comply with UL 778 for motor-operated water pumps.

2.2 PACKAGED, SUBMERSIBLE SEWAGE-PUMP UNITS

A. Packaged, Submersible, Nonclog, Sewage-Pump Units:

1. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, sewage-pump unit.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Liberty Pumps.
   b. Little Giant; a brand of Franklin Electric Co., Inc.
   c. Zoeller Pump Company.

3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron.
5. Impeller: Brass, bronze, or polymer; statically and dynamically balanced, non-clog design, and capable of handling solids diameter indicated on the Drawings.
6. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
7. Controls for Duplex Pump: Automatic, with mechanical- or mercury-float switches and automatic alternator which swaps lead pump on each cycle for equal pump wear. Float switch heights preset on stainless steel rod separate from pumps, allowing float replacement without disturbing pumps or piping. Alternator activates only one pump at a time; when high water alarm is activated the lead pump turns off and the standby pump turns on. Wall-mounted control panel with: power cord with 3-prong plug; pump power receptacles; individual pump fuses or circuit breakers; float cord quick-connects; audible alarm horn; indicator lights for power, pump run, high water alarm, and horn silenced; auxiliary contacts for remote alarm monitoring; pushbuttons for testing and silencing; and 9-volt battery backup for alarm light and horn with 1-minute auxiliary alarm relay operation. A timed pump-run limiter protects the pumps against run-dry situations, by stopping the pump after a preset time period if the high-level float switch remains closed but the primary float switch is open.
8. Basin: Watertight plastic and of size required for pumps, suitable for mounting on top of floor, with pump torque limiters, inlet pipe connection and gastight cover with pump discharge and vent connections, individual bolted access covers for each pump and for control float system.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."

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.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

3.2 INSTALLATION

A. Equipment Mounting:

1. Install packaged pumps on the floor surface, with basins braced to prevent movement.

B. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

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. Coordinate wiring of auxiliary alarm contacts with Division 23 of the Specifications.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.

B. Perform the following 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 motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221329

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sump pumps - submersible.
2. Oil-sensing sump pumps and controllers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Data Submittals: For each product.

1. Construction details, material descriptions, dimensions of individual components and profiles.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls.

1. Indicate actual installed items by marking submittals with an arrow or box.

1.4 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 manufacturer's written instructions for handling.

1.5 WARRANTY

A. Manufacturer Warranty: Manufacturer agrees to repair or replace sump pumps that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of sump pump from single source from single manufacturer.

2.2 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.3 OIL-SENSING SUMP PUMPS AND CONTROLLERS

A. Oil-Sensing Sump Pumps and Controllers: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flo Fab Inc.
    b. Liberty Pumps.
    c. Little Giant; a brand of Franklin Electric Co., Inc.
    d. Weil Pump; a Wilo Company.
    e. Zoeller Company.

2. Description: Factory-assembled and -tested sump-pump unit. ASME A17.1 compliant.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 14.1-14.2 and HI 14.3.
4. Pump Casing: Cast iron, with strainer inlet; legs that elevate pump to permit flow into impeller; and vertical discharge for piping connection.

5. Controls:

    a. Industrial-grade switch(es) with internal 20 A relay and Type 304 stainless steel sensor probes.
    b. Liquid/oil sensor that differentiates and indicates the presence of oil and/or water under high-water conditions.
    c. Alarm Panel:

        1) High-oil-level alarm.
        2) High-water-level alarm.
        3) Audible and visual alarms for each alarm condition.
        4) Dry contacts for remote monitoring of oil, water, and high liquid conditions.

    d. Control Panel:

1) Simplex.
2) Enclosure: NEMA 250, Type 4X.
3) HOA switch(es).
4) Green pump run light; power on light.
5) Pump circuit breaker(s).

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."

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.

B. Motors for submersible pumps are to be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump-pump installation.

3.2 INSTALLATION

A. Pump Installation Standards: Comply with HI 14.4 for installation of sump pumps.

B. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

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. Provide interconnecting power and control wiring between components.

E. Provide protective enclosure for remote alarm panel to prevent tampering.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221414 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

3.5 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.6 FIELD QUALITY CONTROL

A. 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 motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Pumps and controls will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

ecSECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor-mounted, bottom-outlet water closets.
2. Toilet seats.

1.2 DEFINITIONS

A. High-Efficiency Flush Volume: 1.28 gal. or less per flush.

B. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 ACTION SUBMITTALS

A. Product Data:

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.

B. Shop Drawings: Include diagrams for power and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flush tank mechanisms to include in operation and maintenance manuals.

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 water closets and tanks.
3. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.

4. Comply with ICC A117.1 for ADA-compliant water closets.
5. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
6. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

2.2 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets - Floor Mounted, Bottom Outlet, Close-Coupled Flushometer Tank: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard.
    b. Kohler Co.
    c. Sloan Valve Company.
    d. Toto USA, Inc.
    e. Zurn Industries, LLC.

2. Source Limitations: Obtain water closets from single source from single manufacturer.
3. Bowl:

    a. Material: Vitreous china, with SloanTec hydrophobic antimicrobial glaze.
    b. Type: Siphon jet.
    c. Style: Flushometer tank, pressure assisted with Sloan Flushmate.
    d. Height: ADA compliant.
    e. Rough-In Distance: 12 inches.
    f. Rim Contour: Elongated.
    g. Water Consumption: 1.28 gal. per flush.
    h. Color: White.
    i. Handle: Chromed metal with cable operator. Locate handle on the wide wheelchair approach side regardless of model number on Drawings.
    j. MaP (Maximum Performance) Score: At least 1,000 grams of solid waste (test medium of soybean paste and toilet paper) per flush, with independent testing certifications.
    k. Water Pressure Range: 20 to 80 psig static pressure.

2.3 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard.
    b. Bemis Manufacturing Company.
    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: Self-sustaining, check.
7. Post and Pintle Material: Noncorroding 300-series stainless steel.
8. Seat Cover: None.
9. Color: White.

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.

3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

B. Install toilet seats on water closets.

C. 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 220518 "Escutcheons for Plumbing Piping."

D. Joint Sealing:

1. Seal joints between water closets 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 079200 "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 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets. Replace damaged and malfunctioning water closets and fittings.

3.5 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 Owner.

END OF SECTION 224213.13

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. Thermostatic mixing valves.
4. Supply fittings.
5. Waste fittings.
6. Lavatory supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Rectangular, Vitreous China, Wall Mounted, with Back:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. Sloan Valve Company.
d. Toto USA, Inc.
e. Zurn Industries, LLC.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging, with backsplash.
c. Nominal Size: Rectangular, 20 by 18 inches.
d. Faucet-Hole Punching: One hole.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Finish: SloanTec hydrophobic antimicrobial glaze.
h. Mounting Material: Chair carrier.

3. Faucet: See "Automatically Operated Lavatory Faucets" Article.
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. Faucets must 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 - Automatic Type: Battery Powered Electronic Sensor Operated, Mixing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Chicago Faucets; Geberit Group.
b. Hydrotek International, Inc.
c. Kohler Co.
d. Sloan Valve Company.
e. Speakman Company.
f. T&S Brass and Bronze Works, Inc.

2. Standards: ASME A112.18.1/CSA B125.1; ADA compliant to ICC/ANSI A-117.1.
3. General: Include side-mounted lever mixer temperature adjustment handle with hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor. Mixing and flow control components integral to faucet body, entirely above lavatory top mounting surface.
4. Body Type: Single hole.
5. Body Material: Commercial, cast solid-brass or die-cast metal with copper-alloy waterways.

6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 0.5 gpm.
8. Mounting Type: Deck, concealed.
9. Spout: Rigid type.
10. Spout Outlet: Aerator.
11. Drain: Not part of faucet.
12. Aerator Outlet Height: At least 4 inches above lavatory faucet-mounting deck.
13. Aerator Centerline Distance: At least 4 inches horizontal from centerline of faucet body.
14. Timeout: Adjustable with 15-second default setting.
15. Battery: 6-Volt CR-P2 lithium commercial type, 3 years at 8,000 cycles per month.

2.3 THERMOSTATIC MIXING VALVES

A. Thermostatically controlled automatic valve, ASSE 1070 approved; with scald protection and flow check valves. Range of minimum to maximum flow rates including the range of 75 to 150 percent of faucet flow rate. Controlled outlet temperature adjustable setting including the range 95 to 115°F. Wall-mounting flange with fastener holes integral to or separate from valve body, to hold body firmly in recommended position.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Caleffi North America, Inc.
    b. Lawler Manufacturing Co., Inc.
    c. Leonard Valve Company.
    d. Powers; a Watts Water Technologies company.
    e. Watts; a Watts Water Technologies company.
    f. Zurn Industries, LLC.

B. Provide in supply piping below each lavatory, in accordance with Uniform Plumbing Code 2021 Chapter 407.3. Fasten to wall or partition framing, level and in inconspicuous location with service clearances; trim or coil excess tubing to avoid interferences with people and piping.

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 valve with inlet connection matching supply piping, lever handle.

E. Risers: Chrome-plated, soft-copper flexible tube riser. NPS 1/2.

2.5 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 1-1/2 by NPS 1-1/4.
2. Material:

a. Chrome-plated, 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.
b. Stainless steel, two-piece trap and swivel elbow with 0.012-inch thick stainless steel tube to wall, and stainless steel wall flange.

2.6 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
e. Wade; a subsidiary of McWane Inc.
f. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.

3. Steel, floor mounted with concealed arms.

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 walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

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 220518 "Escutchons 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 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

G. Insulate mixing valves and supply tubing. 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 piping requirements specified in Section 221116 "Domestic Water Piping," and Section 221316 "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. Provide protective covering; do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service sinks.
2. Kitchen/utility sinks.
3. Manually operated sink faucets.
4. Supply fittings.
5. Waste fittings.
6. Grout.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. 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 100 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 100 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

A. Service Sinks - Terrazzo, Floor Mounted Mop Basin.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Engineering Company.
    b. Florestone, Inc.
    c. Murdock Manufacturing.
    d. Stern Williams.

2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:

    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: Five sided .
    c. Nominal Size: 24 by 24 inches .
    d. Height: 12 inches with dropped front.
    e. Tiling Flange: On two sides.
    f. Rim Guard: On front top surfaces.
    g. Color: Not applicable >.
    h. Drain: Dome strainer with NPS 3 outlet.

4. Mounting: On floor and flush to wall. Submit and conform to manufacturer’s installation instructions and details; see Part 3 of this Section for information.
5. Faucet: Mop Basin faucet from "Manually Operated Sink Faucets" Article.
6. Accessories: As scheduled on Drawings including:
    a. Hose with wall hanger.
    b. Mop hanger.
    c. Stainless steel wall guards.

2.2 KITCHEN/UTILITY SINKS

A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Engineering Company.
    b. Advance Tabco.
    c. Elkay.
    d. Just Manufacturing.

2. Source Limitations: Obtain sinks from single source from single manufacturer.

3. Fixture:

    a. Standard: ASME A112.19.3/CSA B45.4.
    b. Type: Stainless steel, self-rimming, sound-deadened unit less ledge back.
    c. Number of Compartments: One.
    d. Material: 18 gauge, Type 304 stainless steel.
    e. Compartment: Wheelchair accessible depth, 3-1/2” drain offset to near side-rear.
    f. Drain Fitting: Elkay LK99 or equal with Type 304 stainless steel basket and rubber stopper.
    g. Mounting: On counter with sealant.

4. Faucets): Kitchen Sink faucet from "Manually Operated Sink Faucets" Article.

5. Supply Fittings:

    a. Standard: ASME A112.18.1/CSA B125.1.
    b. Supplies: Chrome-plated brass stoopball valve with lever handle, with inlet connection matching water-supply piping type and size.
        1) Risers: NPS 1/2, ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

6. Waste Fittings:

    a. Standard: ASME A112.18.2/CSA B125.2.
    b. Trap(s): Size: NPS 1-1/2.
        1) 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.
            b) Stainless steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless steel tube to wall; and stainless steel wall flange.

    c. Continuous Waste: Chrome-plated, 17-gauge brass tube. NPS 1-1/2.

2.3 MANUALLY OPERATED SINK FAUCETS

A. Faucets must 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: Single-control mixing, for Kitchen Sink.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Blanco; Linus model 526366 in PVD Steel finish.

b. California Faucets; Corsano model K51-111-PN polished nickel finish, or K51-111-USS Ultra Stainless Steel finish.
c. Grohe; Minta model 30300DCO in SuperSteel finish.
d. Kohler Co.; Purist model K-7506-VS in Vibrant Stainless finish.
e. No substitutions.

2. Standard: ASME A112.18.1/CSA B125.1; ADA compliant to ICC/ANSI A-117.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Single hole.
5. Body Material: Commercial grade, solid brass housing, or die-cast housing with brazed copper and brass waterway. Ceramic disc valve cartridge.
6. Finish: Stainless steel or satin nickel color.
7. Maximum Flow Rate: 1.5 to 1.8 gpm.
8. Mounting Type: Deck, concealed.
9. Valve Handle: Single lever mounted low on side of faucet riser. If handle swings away from user, coordinate sink and faucet location with backsplash for clearance.
10. Spout Type: Swivel high-arch gooseneck, with 90-degree bend to horizontal extension.
11. Spout Outlet: Outlet 7-3/8 in. to 11-5/8 in. above faucet deck, and centerline 6-3/8 in. to 8-13/16 forward from faucet mounting base centerline.
12. Spout Configuration: Pull-out type, with integral braided hose and swiveling joint. One or two pushbuttons select between spray and laminar or aerated flow.

C. Commercial Service Sink Faucets - Manual Type: Two-handle type, for Service Sink.

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. T&S Brass.

2. 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.
3. 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. Finish: Rough chrome plated.
c. Handles: Lever.
d. Cartridges: Ceramic.
e. Brace: Adjustable top brace.

4. Vacuum Breaker: Required for hose outlet.
5. Spout Outlet: Hose thread in accordance with ASME B1.20.7.

2.4 THERMOSTATIC MIXING VALVES

A. Thermostatically controlled automatic valve, ASSE 1070 approved; with scald protection and flow check valves. Range of minimum to maximum flow rates including the range of 75 to 150 percent of faucet flow rate. Controlled outlet temperature adjustable setting including the range 95 to 120°F. Wall-mounting flange with fastener holes integral to or separate from valve body, to hold body firmly in recommended position.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Caleffi North America, Inc.
    b. Lawler Manufacturing Co., Inc.
    c. Leonard Valve Company.
    d. Powers; a Watts Water Technologies company.
    e. Watts; a Watts Water Technologies company.
    f. Zurn Industries, LLC.

B. Provide in supply piping below each sink. Fasten to wall or partition framing, level and in inconspicuous location with service clearances; trim or coil excess tubing to avoid interferences with people and piping.

2.5 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 valve with lever handle, inlet connection matching supply piping.

E. Risers: Chrome-plated, soft-copper flexible tube. NPS 1/2 (DN 15).

2.6 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap: 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. NPS 1-1/2.

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. Set floor-mounted sinks in leveling bed of cement grout.

C. Install floor-mounted service sinks and mop basins with 1/4-inch space between sink and the finished surface of building partitions. Lap wall panels over the tiling flanges, and seal top and side gaps watertight. Do not let rough wall materials overlap tiling flange, and do not attach sink tiling flange to the partition or wall.

D. Install water-supply piping with stop on each supply to each sink faucet. Install stops where they can be easily reached for operation.

E. Install wall flanges or escutcheons at piping wall penetrations. Use deep-pattern escutcheons conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between sinks and counters 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 Owner.

END OF SECTION 224216.16

SECTION 230500 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide labor, materials, accessories, and other related items as required to complete operations in connection with the complete installation of the HVAC and mechanical systems as indicated on the Drawings and as specified herein.

1.2 RELATED REQUIREMENTS

A. Conditions of the Contract apply to the work, including the work of this Division. Examine Contract Documents for requirements affecting the work.

B. Provide cooperation with, and assistance to, the Testing and Balancing (TAB) Agent specified in Division 23 Section “Testing, Adjusting, and Balancing for Mechanical Systems.”

1.3 MECHANICAL PRE-CONSTRUCTION MEETING

A. Conduct a mechanical conference at Project site to comply with requirements of Division 01 Section “Project Management and Coordination” and the following:

1. At least 14 days prior to beginning of mechanical work, conduct a meeting to review detailed requirements for mechanical systems installation and testing requirements. Review mechanical Drawings and Specifications, discuss project specific details and requirements, and review and discuss expectations for quality control. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with mechanical systems installation to attend conference, including, but not limited to, the following:

    a. General Contractor's superintendent.
    b. Mechanical Subcontractors’ project managers.
    c. Mechanical Subcontractors’ job foremen.
    d. Sheetmetal job foreman.
    e. Plumbing job foreman.
    f. Controls job foreman.
    g. Project mechanical Engineer/designer.
    h. Job clerk.
    i. Architect’s construction administrator.

1.4 DRAWINGS

A. The general location of the apparatus and the details of the work are indicated on the Drawings. Exact locations not indicated shall be determined at the site as the work progresses and shall be subject to the Architect's approval.

B. It is not intended that the Drawings shall show every pipe, pipe rise, pipe drop, duct rise, duct drop, pipe fitting, duct fitting, or appliance, but it shall be a requirement to furnish, without additional expense, material and labor necessary to complete the systems in accordance with the design intent and with the highest possible quality available.

1.5 ALTERATIONS

A. Execute alterations, additions, removals, relocations, new work, and other related items as indicated or required to provide a complete installation in accordance with the intent of the Contract Documents, including changes required by building alterations.

B. Existing work disturbed or damaged by the alterations or the new work shall be repaired or replaced to the Architect's satisfaction and at no additional cost to the Owner.

C. Existing ductwork, piping, and other systems indicated to be removed, shall be removed from the site. Cap off existing services remaining. The Owner retains the right to ownership of heating and ventilating equipment scheduled to be removed; store such equipment where requested by the Owner. Material not retained by the Owner shall be removed from the site.

1.6 CONTINUITY OF SERVICE

A. Arrange to execute the work at such times and in such locations as may be required to provide uninterrupted service for the building or any of its locations. Any unavoidable conditions requiring reduced building capacity shall be arranged for by programming with the Owner's duly authorized representative at the building subject to the Architect’s approval. If necessary, temporary work shall be installed to provide for the condition. Authorization for interrupting service shall be obtained in writing from the Owner. Any interruption of normal service shall be performed during an overtime period to be scheduled with the Owner. Costs for overtime work shall be included in the Bid.

1.7 REQUIREMENTS

A. Installation Instructions: Obtain manufacturer’s printed installation instructions to aid in properly executing work on major pieces of equipment. Install equipment in accordance with manufacturer’s recommendations.

B. Objectionable Noise, Fumes and Vibration:

1. Mechanical and electrical equipment shall operate without creating objectionable noise, fumes, or vibration, as determined by the Architect.
2. If such objectionable noise, fumes, or vibration is produced and transmitted to occupied portions of building by apparatus, piping, ducts, or any other part of mechanical and electrical work, make necessary changes and additions, as approved, without extra cost to Owner.

C. Equipment Design and Installation:

1. Uniformity: Unless otherwise specified, equipment or material of same type or classification, used for same purposes, shall be product of same manufacturer.
2. Design: Equipment and accessories not specifically described or identified by

manufacturer's catalog number shall be designed in conformity with ASME, IEEE, or other applicable technical standards, suitable for maximum working pressure, and with neat and finished appearance.

3. Installation: Erect equipment aligned, level and adjusted for satisfactory operation. Install so that connecting and disconnecting of piping and accessories can be made readily, and so that parts are easily accessible for inspection, operation, maintenance and repair. Minor deviations from indicated arrangements may be made, as approved.

D. Hanging of Equipment, Ductwork and Piping:

1. Support equipment, ductwork and piping from the top chord of bar joists at the “Panel Points” or from the top flange of beams. Piping 2-inch (50 mm) nominal and smaller may be supported from the bottom chord of the bar joists at the “Panel Points” or from the bottom flange of the beams.

E. Protection of Equipment and Materials: Responsibility for care and protection of materials and mechanical work rests with the Contractor until the entire project has been completed, tested and the project is accepted by the Owner.

F. Foundations:

1. Ceiling Mounting: Where ceiling mounting is indicated or specified, use suspended platform or strap hangers, bracket or shelf, whichever is most suitable for equipment and its location. Construct of structural steel members, steel plates, or rods, as required; brace and fasten to building structure or to inserts as approved, or as detailed.
2. Where floor mounting is indicated, locate equipment on 4 inch (102 mm) high reinforced concrete pad of adequate size with anchors and base plates as required, on pressure-treated sleepers, or on structural steel frame as detailed. The corners of pads shall be chamfered 1 inch (25 mm). Pad and steel sizes and location shall be coordinated with the approved equipment.

1.8 ACCESS PANELS

A. Access panels required for items furnished under Division 23 shall be provided under this Division.

B. Manufacturer, and Model of standard doors: J. L. Industries, Inc., Model WB; Karp Associates, Inc., Model KDW; or The Williams Brothers Corporation of America, Model WB-DW.

C. Access panels shall be standard panels, 12 inch x 16 inch (305 mm x 406 mm) minimum unless indicated otherwise. Panels installed in areas of high moisture concentration, such as locker rooms, near plumbing fixtures, food preparation areas, or outdoors, shall be fabricated of paintable stainless steel or aluminum for corrosion resistance.

D. Doors and frames shall be factory primed. Latches shall be operated by flush face screw.

E. Access panels in fire-rated construction shall have the same UL rating as the building assembly in which they are installed.

F. Provide access panels in building construction where required for access to duct access doors or other components such as valves, air vents, actuators, volume dampers, motorized dampers in ductwork, duct smoke detectors, and other related items.

1.9 ELECTRIC WORK

A. Provide motors, pilot lights, controllers, limit switches, and other related items for equipment provided under Division 23.

B. Except as noted, required line switches, fused switches, and other related items and necessary wiring to properly connect equipment to motors and switches shall be furnished and installed under Division 26, Electric.

C. Provide complete wiring system for automatic temperature controls as specified under Section Division 23 Section “Instrumentation and Controls for Mechanical Systems.”

D. Wiring shall conform to the requirements of the National Electrical Code.

1.10 FIRESTOPPING

A. Firestopping for penetrations of ductwork, piping and equipment through fire rated and smoke rated building assemblies, including but not limited to partitions, walls, floors, ceilings, and roofs, shall be furnished and installed under this Section.

B. Selection of firestopping materials and installation of firestopping materials shall be in accordance with Division 07 Section “Penetration Firestopping.” Coordinate with other trades for a consistent installation.

C. Refer to Architectural Drawings for locations of fire rated building assemblies.

1.11 SUBMITTALS

A. After award of Contract and before installation, submit for approval Shop Drawings, bulletins, Product Data, Samples, and other related items.

B. Submit Shop Drawings and Product Data as required in each Section. Submittal shall include physical data and performance data required to verify compliance with the Contract Documents.

C. Submit Samples as required in each Section, and as indicated on the Drawings. These will generally be retained by the Architect/Engineer, unless otherwise indicated. Contractor may request these items returned; provide return shipping for returns.

D. Submit Mock-Ups as required in each Section, and as indicated on the Drawings. For general mock-up procedures, refer to Division 01 Section “Quality Requirements.” Deliver to the Architect/Engineer for review if so indicated. Provide return shipping.

E. Submit Coordination Drawings in accordance with the Article “Coordination Drawings” in this Section.

F. Architect/Engineer's review will not include the review, coordination, or verification of dimensions or quantities; these shall be the responsibility of the Contractor.

1.12 SUBSTITUTIONS

A. Comply with provisions of the Instructions to Bidders and General Conditions.

B. The first item listed under "Acceptable Manufacturers," "Approved Manufacturers" or "Manufacturers" is the design basis.

1. Other manufacturers listed may be used in the base bid, but conformance with details of the Specifications, as well as dimensional and electrical data, shall be verified by the Contractor.
2. Architect/Engineer has not verified that each listed manufacturer has the ability to provide an acceptable substitution for the basis-of-design product. Contractor may not assume that substitutions will be approved.
3. Modifications required as a result of differences between the design basis item and the submitted and approved item must be approved by the Architect and made at the Contractor's expense. As an example, if a rooftop HVAC unit is submitted and approved and if the unit's dimensions and weight are different from those of the unit which was used as the design basis, the Contractor shall be responsible for building structural modifications required to accommodate the submitted and approved unit, at no additional cost to the Owner.
4. When, in the Architect or Engineer's opinion, architectural or engineering services are necessary for the coordination of substituted items, the Contractor shall reimburse the Owner for the cost of these services.
5. For items which have no manufacturers listed, any item conforming with the Contract Documents is acceptable.

C. Substitutions from manufacturers or providers which are not listed may be proposed within the time allowed in the General Conditions of the Specifications.

1. The exception to this is products for which the list of manufacturers or providers is limited by the wording "no substitutions" or similar wording.

1.13 COORDINATION

A. Confirm and correlate dimensions and weights at the project site for tolerances, clearances, quantities, fabrication processes, and techniques of construction. Coordinate submittals with related building elements. Coordinate the Work with other trades, and verify full compliance with the Contract Documents. Comprehensive coordination and integration of submittals between trades is required and must be completed. Prevent schedule delays, and pay costs resulting from changes and conflicts which have not been fully coordinated as part of the buy-out and submittal preparation.

B. Coordinate scheduling, submittals, and Work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Verify that utility requirement characteristics of operating equipment are compatible with

building utilities. Coordinate work of various Divisions having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate Sections in preparation for Substantial Completion.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.14 COORDINATION DRAWINGS

A. Prepare Coordination Drawings in accordance to the requirements of this Specification. Before work progresses, create Coordination Drawings in AutoCAD (.dwg) electronic format. Deliver the Coordination Drawings to the General Contractor and each of their Subcontractors, in both electronic (.dwg) and printed (paper) format, for inclusion of their respective equipment and systems. Printed Coordination Drawings must include at least one set of reproducible at 3/8-inch per foot scale, and one set for scaling at 3/8-inch per foot scale. Prepare Coordination Drawings in accordance to the requirements of this Specification, and the following:

1. Indicate temporary relocation, phasing, sequencing, and moving of large equipment in the building during construction.

2. Provide floor plans and details, including the following:

   a. Show ductwork, piping, insulation, filters, air-moving equipment, dehumidifiers, heating equipment, terminal equipment, pumps, isolation valves, control valves, thermostats, sensors, controllers, control cabinets, skids, platforms, and the other equipment installed under this Division, showing the adjoining work of the other trades at each floor or enclosure level. Refer to Articles throughout this Section for additional coordination requirements.
   b. Show ductwork and piping including its insulation and fittings in plan views. Identify system types and flow directions, sizes, and insulation thicknesses.
   c. Indicate system supports, supplemental framing, and blocking.
   d. Note apparent conflicts, and suggest alternate solutions.
   e. Show how systems will be installed where conflicts with the work of other trades may occur.
   f. Show sizes, locations, and required clearances of access panels and doors.
   g. Show wiring and conduit routing and sizing associated with the systems of this Division. Identify associated penetrations of building elements.
   h. Prepare the Coordination Drawings to print in color, where that will enhance coordination and differentiation of systems. Bind supporting files with the

AutoCAD files to ensure printing results are as intended.

B. Before submitting Coordination Drawings to the Owner for review, require other Subcontractors to revise the composite Coordination Drawings and submittals and to make reasonable modifications in the layout of their work, so that the HVAC work may be properly accommodated without interference with work of other trades. Revise composite systems Coordination Drawings, when requested, without extra charge or schedule delay. For example, ductwork aspect ratio changes (including up to a 5 to 1 width to height ratio) must be considered reasonable changes and made with no time delay or cost to the Owner.

C. Pay the costs for changes in the HVAC and adjoining work where an approved substitution of the HVAC equipment requires such changes in the HVAC work or in the adjoining work of any other trade. Provide Coordination Drawings showing the proposed changes at time of substitution transmittal.

D. Where installed systems will conflict with ceiling systems or the support thereof, coordinate the method of support and access for the ceiling. HVAC systems must not be used to support the ceiling construction, and must not be placed in line with the ceiling's support points or interfere with raising of lay-in ceiling tiles and other items in the ceiling, unless written approval is obtained from the Architect of record for the specific areas of conflict.

E. Before transmittal of the Coordination Drawings to the Owner for approval, review with and obtain sign-off from each of the Subcontractors indicating that the work of their trade is fully coordinated.

1.15 REQUESTS FOR ARCHITECT'S CADD DRAWINGS

A. In lieu of generating their own CADD drawings, the Contractor may elect to use the Architect's electronic copies of CADD drawings for the purpose of developing coordination drawings, developing control system graphics or for other reasons that pertain to the requirements of this Contract. If the Contractor elects to utilize the Architect's electronic copies of CADD drawings, the electronic files shall be purchased from the Architect at the Architect's current billing rate per drawing. The Contractor shall provide payment and shall sign a release-of-liability form before electronic CADD drawings are released.

1.16 CLEANING

A. Remove debris from site daily.

B. Material and pieces of equipment shall be turned over to the Owner free of dust and dirt, both inside and out.

C. At the completion of the Project, equipment shall have a clean, neat appearance of factory finish by cleaning or repainting as required.

D. At the completion of the Project, surfaces exposed to view shall have a clean, neat appearance of finish free from smudges and scratches by cleaning or repainting as required.

1.17 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect/Engineer 7 days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of responsible manufacturer’s representative in accordance with manufacturer’s instructions.

G. When specified in individual Specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.18 ADJUSTMENTS AND OWNER'S INSTRUCTIONS

A. After completion of the installation work called for in the Contract Documents, furnish necessary mechanics or engineers for the adjustment and operation of the systems, to the end that the systems are perfectly adjusted and turned over to the Owner in perfect working order. Further instruct the Owner’s authorized representative in the care and operation of the installation, providing framed instruction charts, directions, and other related items.

B. Instructors providing Owner training shall be experienced and familiar with the jobsite.

1.19 TESTING

A. After the entire installation is completed and ready for operation, test the systems as outlined in Division 23 Section “Testing, Adjusting and Balancing for Mechanical Systems.” These tests are supplementary to detailed tests specified herein or directed. The Owner will provide water and electric current for the test. Provide necessary labor, test pump, gauges, meters, other instruments, and materials. Perform tests in the presence of the Architect or his representative.

B. Perform other tests specified in individual Sections of this Specification.

1.20 COMPLETION OF SYSTEMS

A. The following mechanical systems shall not be complete until the following conditions are satisfied:

1. Ductwork Systems:

a. Ductwork and related components and accessories shall be completely installed and insulated as specified.
b. Ductwork shall be balanced and a balancing report shall be submitted and approved.
c. Commissioning shall be completed.

2. Piping Systems:

a. Piping, valves and accessories shall be completely installed, insulated and labeled as specified.
b. Piping pressure testing be completed and pressure testing reports shall be submitted and approved.
c. Piping systems shall be balanced and a balancing report shall be submitted and approved.
d. Commissioning shall be completed.

3. Equipment:

a. Equipment, including but not limited to boilers, heat exchangers, terminal heat transfer units, pumps, air handling units, condensing units, split system air conditioning equipment, and exhaust fans, shall be completely installed.
b. Equipment start-up reports shall be completed, submitted and approved.
c. Equipment balancing shall be completed and the balancing report shall be submitted and approved.
d. Commissioning shall be completed.

4. Automatic Temperature Controls (ATC):

a. ATC system shall be completely installed.
b. Commissioning shall be completed.
c. ATC system shall operate in an automatic mode for a minimum of 4 months during Owner occupancy without substantial deficiencies.

1.21 OPERATING AND MAINTENANCE MANUALS

A. Furnish 2 bound operating and maintenance manuals and forward to the Architect for review and transmittal to the Owner.

B. For maintenance purposes, provide approved Submittals, parts lists, specifications, and manufacturer's maintenance bulletins for each piece of equipment. For materials used which have been submitted to the Architect for approval but do not require regular maintenance, such as piping, ductwork, and insulation, provide one copy of approved Submittals.

C. Provide name, address and telephone number of the manufacturer's representative and service company, for each piece of equipment or material so that service or spare parts can be readily obtained.

1.22 WARRANTY

A. Provide guarantees and warranties for work under this Contract as indicated in the general requirements of the Contract.

B. Provide manufacturers' standard warranties and guarantees for work by the mechanical trades. However, such warranties and guarantees shall be in addition to and not in lieu of other liabilities which the manufacturer and the Mechanical Contractor may have by law or by other provisions of the Contract Documents.

C. Guarantee that elements of the systems provided under this Contract are of sufficient capacity to meet the specified performance requirements as set forth in these Specifications or as indicated on the Drawings.

D. Upon receipt of notice from the Owner of failure of any part of the mechanical systems or equipment during the warranty period, the Mechanical Subcontractor shall replace the affected part or parts.

E. Furnish a written guarantee covering the above requirements before submitting the application for final payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 230500

SECTION 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Common requirements for electric motors furnished on equipment specified in other Sections, including single phase and three phase electric motors.

B. Starters.

C. Thermal Overload Protection.

1.2 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.

B. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

C. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

D. NEMA MG 1 - Motors and Generators.

E. NFPA 70 - National Electrical Code.

F. UL 508A - Industrial Control Panels.

G. UL 674 - UL Standard for Safety Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

H. UL 1836 - UL Standard for Safety for Electric Motors for Use in Class I, Division 2 and Class II, Division 2 Hazardous (Classified) Locations.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.4 REGULATORY REQUIREMENTS

A. Conform to UL Component Recognition for appropriate sizes.

B. Conform to NFPA 70 and local energy code.

1.5 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 MOTORS

A. Acceptable Manufacturers:
1. Baldor-Reliance – a division of ABB Motors and Mechanical Inc.
2. Century Electric Motors – a brand of Regal Beloit Corp.
3. Fasco – a brand of Regal Beloit Corp. – for motors 1 hp (0.75 kW) and under.
4. General Electric – a brand of General Electric Power Conversion.
5. Greenheck Fan Corporation - Vari-Green EC fan motors.
6. Leeson – a brand of Regal Beloit Corp. – for motors 1 hp (0.75 kW) and under.
7. Marathon Motors – a brand of Regal Beloit Corp.
8. Siemens Industry Inc.
9. Simotics – a brand of Siemens Industry Inc.
10. Teco-Westinghouse Motor Company.
11. Toshiba International Corp.
12. U.S. Motors (division of Emerson Motor Technologies).
13. WEG Electric Corp.

B. General Construction and Requirements:
1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer’s standard and need not conform to these Specifications.
2. Motors shall have integral thermal overload protection.
3. Single Phase Motors for general applications: PSC (permanent split capacitor) where available.
4. Single Phase Motors for fans:
    a. EC (electronically commutated) where available.
    b. PSC (permanent split capacitor) where available, if EC is not available.
5. Open drip-proof type except where specifically noted otherwise.
6. Design for continuous operation in 40 degrees C environment.
7. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
8. Visible Nameplate: Indicating manufacturer’s name and model number, motor horsepower, RPM, frame size, voltage, phase, cycles, full load amps, insulation system class, service factor, maximum ambient temperature, temperature rise at rated horsepower, minimum efficiency.

C. Single-Phase Power for Fans - Electronically-Commutated (EC) Motors - Also Known As Brush-Free DC (BFDC) Motors:
1. Drive: Direct-drive only, not for use with belt drive.

2. Power Supply: Internal motor circuitry shall convert AC power supplied to DC power to operate the motor.
3. Turndown: Speed-controllable down to 20 percent of full speed (80 percent turndown).
4. Speed Control: Integral potentiometer with screwdriver setting, remote potentiometer dial with 24 VDC transformer to generate a 0-10 VDC signal, or integral circuitry to accept a 0-10 VDC signal from the building control system, as indicated and specified.
5. Efficiency: Minimum of 85 percent efficient at all speeds.
6. Soft-start type, capable of reliable start at any speed setting.
7. Enclosure: Open drip-proof.
8. Bearings: Permanently lubricated heavy duty ball bearings.
9. Overload Protection:
    a. Automatic Speed Control: In the event of overheating or overloading, the motor electronics slow the motor to operate within its acceptable range.
    b. Thermal Overload: Internally fused, one-shot type as a last resort to prevent fires.
    c. Locked Rotor: If the motor sees a locked rotor condition, it will automatically shut itself down, then try to restart 3 times. After the 3rd try, the motor will not attempt to restart until the power is cycled.

D. Single Phase Power - Permanent-split Capacitor Motors:
1. Starting Torque: Exceeding one fourth of full load torque.
2. Starting Current: Up to six times full load current.
3. Multiple Speed: Through tapped windings.
4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

E. Single Phase Power - Capacitor Start Motors:
1. Starting Torque: Three times full load torque.
2. Starting Current: Less than five times full load current.
3. Pull-up Torque: Up to 350 percent of full load torque.
4. Breakdown Torque: Approximately 250 percent of full load torque.
5. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated bearings.
7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

F. Single Phase Power - Split Phase Motors:
1. Starting Torque: Less than 150 percent of full load torque.
2. Starting Current: Up to seven times full load current.
3. Breakdown Torque: Approximately 200 percent of full load torque.
4. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
5. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.2 STARTERS AND OVERLOADS

A. Acceptable Manufacturers:
1. Franklin Control Systems.
2. Allen-Bradley (division of Rockwell Automation).
3. Cutler Hammer (division of Eaton Corporation).
4. General Electric.
5. Siemens.
6. Square D (division of Schneider Electric).

B. Provide motor starters for motors provided under this Division of these Specifications.

C. Franklin Control Systems "BAS" building automation HVAC starters are the basis of design. Features of starters/contactors, disconnects, and temperature controls shall be combined in a single package using these starters. Coordination with Automatic Temperature Controls supplier and installer is required to reduce total project costs.
1. Single-phase starter (Franklin Control Systems BAS-1P series) features include:
   a. Manually operated quick-make toggle mechanism lockable in the "Off" position, which shall also function as the motor disconnect.
   b. Hand/Auto switch, concealed behind sliding cover to discourage tampering.
   c. Capability to operate in both manual and automatic control modes. In automatic mode, the starter shall have the capability to integrate with a building automation system by providing terminals for run input, run status output, and fault output.
   d. Control terminals integrated in the starter.
   e. Power, run status, and fault LED pilot lights.
   f. Interposing run relay and current sensing status output relay.
   g. Voltage and dry inputs for auto run command.
   h. System override mode (fireman's, occupancy, or manual).
   i. Solid-state electronic overload with wide adjustment range and highly accurate digital motor protection, including protection for stall and locked rotor conditions. Class 10. Concealed adjustment behind sliding cover.
   j. Surface mount enclosure, UL Type 1, single gang box installation, with sliding covers for concealed items.
   k. Power Input: 1-phase, 110-240 VAC, 1-16 Amps, 0.1-1 HP (75 to 745 W).
   l. Universal Control Inputs: Voltage auto-run 10-130 VAC/DC to energize. Dry auto-run normally-open dry contact closure.
   m. Control Outputs: Proof of run and fault, normally-open 0.3 Amps at 125 VAC, 1 Amp at 24 VAC.
   n. Ambient operating temperature -5 to 140 degrees F (-20 to 60 degrees C).
   o. UL 508A Listed.
   p. 5-year warranty.

D. Feature Descriptions:
1. Fireman's Override Input: Causes the starter to run the motor in any mode (Hand, Off or Auto) regardless of other inputs or lack of inputs either manual or auto. The purpose of the Fireman's Override input is to act as a smoke purge function. Fireman's Override has priority over the Emergency Shutdown input.
2. Emergency Shutdown Input: Disables the starter from operating in either Hand or Auto mode regardless of other inputs either manual or auto.

3. Cycling Fault Protection: Activates whenever the starter is cycled at a rate of more than 1000 cycles in a one hour period. This feature shall be selectable to be disabled. Cycling fault shall cause overload LED to blink rapidly.

E. Contactors in starters shall be general purpose NEMA rated for connected H.P. (definite purpose starters not acceptable). Coordinate control voltage with Controls Contractor. Provide auxiliary contacts where required for interlocking of electrical equipment. Provide 2-speed motor starters where indicated or required.

F. Single phase motors shall have one of the following factory wired methods of motor protection:
1. Integral thermal overload protection in motor and cord with plug and receptacle in unit casing.
2. Integral thermal overload protection in motor and disconnecting switch mounted in or on casing as specified with equipment.
3. Switch with thermal overload protection for unprotected motors with switch serving as disconnect device.

G. For starters associated with equipment that is required to be shut down upon a fire alarm condition, provide input contacts within the starter enclosure to interface with the building's fire alarm system. Upon receipt of a signal from the building's fire alarm system, power to load side of the starter shall be turned off. Circuitry shall be provided to ensure that power is off whether the starter is in the "AUTO", "HAND" or "BYPASS" mode. If this feature is not available from the starter manufacturer, provide a contactor on the line side of the starter to accomplish the same function. The contactor shall meet the requirements of Division 26.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Division 01 Section "Quality Requirements": Manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Coordinate with Division 26 "Electrical."

D. Check line voltage and phase and direction of rotation, and ensure agreement with nameplate.

E. Install guards in accordance with Codes and OSHA requirements.

F. Adjust motor overload devices based on motor amperage ratings and field measurements of running amps, to ensure protection of the motor and eliminate nuisance trips.

G. Disconnect Switch Mounting Height: Install at height above finished floor in accordance with NFPA 70.
1. In most instances, the center of the grip of the disconnect switch operating handle in its highest position shall be no more than 79 inches above finished floor or working platform.
2. Switches and circuit breakers installed adjacent to the equipment served and within 79 inches above finished floor or working platform.

END OF SECTION 230513

SECTION 230517 – SLEEVES AND ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe Sleeves.

B. Escutcheons.

C. Floor Plates.

1.2 RELATED SECTIONS

A. Division 23 Section “Common Work Results for HVAC” – Firestopping.

B. Division 23 Section “Hydronic Piping.”

C. Division 23 Section “Refrigerant Piping.”

1.3 REFERENCES

A. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

B. ASTM C1107 - 11 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

1.4 PERFORMANCE REQUIREMENTS

A. Provide sleeves for piping penetrations of building construction such as interior partitions, interior and exterior walls, floors, and roofs.

B. Provide escutcheons and floor plates at piping penetrations of building construction.

C. Coordinate

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Product Data: For each type of product indicated.

C. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Project Record Documents.”

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01.

B. Protect materials from exposure by leaving factory coverings and packaging in place until installation.

1.10 WARRANTY

A. Provide warranty under provisions of Division 01 Section “Closeout Procedures.”

PART 2 - PRODUCTS

2.1 PIPE SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A53, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A53, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 ESCUTCHEONS

A. Material: Brass at floors and in potentially damp or wet locations. Brass or steel in other locations.

B. Finish: Except as indicated below, polished chrome plated in exposed locations, prime painted steel or rough brass in mechanical rooms and similar spaces.

C. One-Piece, Cast-Brass Type: With finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

F. Split-Casting Brass Type: With concealed hinge and setscrew.

G. Split-Plate, Stamped-Steel Type: With chrome-plated finish, hinge, and spring-clip fasteners.

2.3 FLOOR PLATES

A. Material: Brass in exposed locations.

B. Finish: Except as indicated below, polished chrome plated in exposed locations, rough brass in mechanical rooms and similar spaces.

C. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

C. Size sleeves to allow firestopping.

D. Size holes and sleeves to allow the required clear annular space for insulation, and at least 1/4 in. clear outside the pipe and insulation for movement due to expansion and contraction.

E. Cut sleeves flush with both surfaces, except at floors.

F. Extend sleeves through floors as follows: In locations not otherwise indicated, 2 inches above finished floor level. In normally-dry locations such as finished office spaces under fintube and baseboard radiation, 1 inch above finished floor level. Finished floor level includes the thickness of floor finish materials such as carpet and tile. Caulk sleeves full depth and provide floor plate.

G. Fasten sleeves permanently in place.

H. Using grout, seal the space outside of sleeves in concrete slabs and walls.

I. Provide escutcheons for piping penetrations of walls, ceilings, and finished floors.

J. Escutcheons and floor plates on bare piping: one-piece type where possible. Escutcheons and floor plates on insulated piping and on existing piping: split, hinged type.

K. Size escutcheons and floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

END OF SECTION 230517

SECTION 230519 – METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pressure gauges and Pressure gauge taps.

B. Static pressure gauges.

C. Filter gauges.

D. Test Plugs.

E. Thermometers and thermometer wells.

F. Thermowell heat transfer paste.

1.2 RELATED SECTIONS

A. Division 23 Section “Hydronic Piping.”

B. Division 23 Section “Air-to-Air Energy Recovery Equipment.”

C. Division 23 Section “Convection Heating and Cooling Units.”

D. Division 23 Section “Instrumentation and Controls for Mechanical Systems.”

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.

B. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

C. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.

D. ASTM D217 - Standard Test Methods for Cone Penetration of Lubricating Grease.

E. ASTM D566 - Standard Test Method for Dropping Point of Lubricating Grease.

F. ASTM E1 - Standard Specification for ASTM Thermometers.

G. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

H. MIL-HDBK-217F – Military Handbook – Reliability Prediction of Electronic Equipment.

I. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

1.5 SUBMITTALS

A. Division 01 Section "Submittal Procedures": Procedures for submittals.

B. Product Data: Provide manufacturers data and list which indicates use, operating range, total range, accuracy, and location for manufactured components.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section "Closeout Procedures."

B. Project Record Documents: Record actual locations of components and instrumentation.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section "Operation and Maintenance Data."

B. Include instructions for calibrating instruments.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section "Product Requirements": Environmental conditions affecting products on site.

B. Do not install instruments when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

A. Manufacturers:
1. Weiss Series 4CTS.
2. Ametek.
3. Ashcroft.
4. Dwyer.
5. Marsh Bellofram.
6. Marshalltown.
7. Trerice 600 Series.

B. Gauge: Non-filled type, with bourdon tube, rotary brass movement, brass socket, soft-soldered connections, front recalibration adjustment, black scale on white-finished metal background.
   1. Case: Cast aluminum or stainless steel.
   2. Lens: Push-in Lexan polycarbonate, or clear glass or acrylic with stainless steel ring, per manufacturer's standard.
   3. Bourdon Tube: Phosphor bronze.
   4. Dial Size: 4 to 4-1/2 inch.
   5. Connection: Lower, 1/4" NPT.
   6. Accuracy: 1 percent of full scale range, per ANSI-ASME B40.1 Grade 1A.
   7. Scale: Psi.
   8. Range: 0-60 psig typical, select for application.

C. Verify suitability of range for each application. Best selection is for typical reading to be close to mid-scale.

2.2 PRESSURE GAUGE TAPPINGS

A. Ball Valve: Provide under Division 23 Section "Hydronic Piping."

B. Pulsation Damper:
   1. Manufacturers:
      a. Weiss.
      b. Ametek.
      c. Dwyer.
      d. Marsh Bellofram.
      e. Trerice.
   2. Pressure snubber, brass with 1/4 inch NPT connections.

2.3 STATIC PRESSURE GAUGES

A. Dial Gauges:
   1. Manufacturers:
      a. Dwyer.
      b. Ametek.
      c. Marsh Bellofram.
      d. Trerice.
   2. 3-1/2 inch diameter dial in metal case, diaphragm actuated magnet and helix, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

B. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

C. Provide at each set of filters in energy-recovery ventilation units (ERVs) and blower coils (BCs).

2.4 TEST PLUGS

A. Test Plug:
1. Manufacturers:
a. Peterson Equipment Co., Inc., “Pete’s Plugs.”
b. Flow Design, Inc.
c. Trerice.
d. Weiss.
2. 1/2 inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with self-closing valves as follows:
a. Nordel (EPDM) core for water and hydronic heating and cooling service, temperatures range 30 to 275 degrees F.
b. Neoprene core for natural gas or LP gas service, temperature range -40 to 150 degrees F.
c. Verify core suitability for other fluids and temperatures.
3. Working Pressure: 500 psig
4. Cap Retaining Strap: Color coded to indicate core material.
5. Construction with either dual self-closing valves (Pete’s Plug standard design) or single valve are allowed.
6. For chilled water applications, provide “XL” plugs which include a 1-1/2 inch extension for insulated piping.

B. Pressure and Temperature Test Kit: Furnish 1 to the Owner.
1. Carrying case with inside foam padding.
2. Pressure gauge, liquid filled with 1/4 inch NPT connection, range 0 to 100 psig, with gauge adapter attached.
3. Additional gauge adapter with 1/8 inch diameter probe and protecting shield.
4. Bimetal thermometer, range 25 to 125 degrees F, 5 inch stem, 1-3/4 inch dial, external calibration.
5. Bimetal thermometer, range 0 to 220 degrees F, 5 inch stem, 1-3/4 inch dial, external calibration.
6. If extended “XL” plugs are used, provide the XL test kit which is suitable for any length of plug.

2.5 THERMOMETERS - DIAL

A. Manufacturers:
1. Weiss.
2. Ametek.
3. Ernst.
4. Trerice.

B. Thermometer: Weiss Model 45VA, ASTM E1, stainless steel or cast aluminum case, adjustable angle with front recalibration, vapor actuated, black scale on white-finished metal background, black pointer, sealed lens, brass stem.
1. Size: 4 to 4-1/2 inch dial.
2. Lens: Snap-in Lexan polycarbonate with o-ring, or clear glass with rubber ring.
3. Bulb: Copper. Provide extended bulb for socket extension in insulated pipe.
4. Extended Bulb: Where required, provide extended capillary tube with braided copper

protection.
5. Connection: Separable socket.
6. Accuracy: 1 scale division throughout range.
7. Calibration: Degrees F.
8. Scale Range: 0 to100 degrees F for plumbing cold water systems; 30 to 240 degrees F for plumbing hot water, hot water heating, and supply air systems.
9. Graduations: 2 degrees F.
10. Air Duct Flange: Provide for duct applications.

2.6 THERMOMETER SUPPORTS

A. Socket (Thermometer Well) for Piping: Brass separable sockets for thermometer stems, with extensions for insulated piping. Provide with Honeywell viscous heat transfer paste.

B. Flange for Duct: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.7 THERMOWELL HEAT TRANSFER PASTE

A. Manufacturers:
1. MG Chemicals.
2. Honeywell.
3. Trerice.

B. Description:
1. Formulation: Silicone or synthetic base, containing metal oxides.
2. Thermal Conductivity: At least 4.5 Btu-in./(hr-ft^2-^{o}F).
3. Temperature Range: To 392 degrees F.
4. Flash Point: 500 degrees F.
5. Dropping Point: ASTM D566, greater than 500 degrees F.
6. Specific Gravity: 2.3 minimum at 77 degrees F.
7. Consistency: ASTM D217, 310 to 320.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Division 01 - Quality Requirements: Manufacturer's instructions.

B. Install 1 pressure gauge per pump, with taps on suction and discharge of pump; pipe to gauge.

C. Install gauge taps in piping; refer to Division 23 Section “Hydronic Piping.”

D. Install pressure gauges with pulsation dampers. Provide valve to isolate each gauge; see “Pressure Gauge Tappings” in this Section. Extend nipples to allow clearance from insulation.

E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller

than 2-1/2 inches for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

F. Install thermometers in air duct systems on flanges.

G. Fill thermometer sockets with heat transfer paste.

H. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.

I. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

J. Coil and conceal excess capillary on remote element instruments.

K. Install static pressure gauges to measure across filters and filter banks (inlet to outlet). On multiple banks, provide manifold and single gauge.

L. Provide instruments with scale ranges selected according to service with largest appropriate scale.

M. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

N. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

O. Locate test plugs where indicated.

END OF SECTION 230519

SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and equipment hangers and supports.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.2 RELATED SECTIONS

A. Division 03 Section “Cast-In-Place Concrete”: Equipment bases.

B. Division 07 Section “Through-Penetration Firestop Systems”: Joint seals for piping and duct penetration of fire rated assemblies.

C. Division 09 Sections - painting.

D. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

E. Division 23 Section “HVAC Piping Insulation.”

F. Division 23 Section “HVAC Equipment Insulation.”

G. Division 23 Section “Hydronic Piping.”

H. Division 23 Section “Hydronic Pumps.”

I. Division 23 Section “Refrigerant Piping.”

J. Division 23 Section “Metal Ducts.”

K. Division 23 Section “Condensing Boilers.”

L. Division 23 Section “Packaged Compressor and Condenser Units.”

M. Division 23 Section "Air-to-Air Energy Recovery Equipment."

N. Division 23 Section “Split-System Air Conditioners.”

O. Division 23 Section “Convection Heating and Cooling Units.”

P. Division 23 Section “Steam Humidifiers.”

Q. Division 23 Section “Indoor, Mechanical Dehumidification Units.”

1.3 REFERENCES

A. ASME B31.1 - Power Piping.

B. ASME B31.2 - Fuel Gas Piping.

C. ASME B31.5 - Refrigeration Piping.

D. ASME B31.9 - Building Services Piping.

E. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

F. ASTM A653 G90 SS Gr. 33 - Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot Dipped Process.

G. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

H. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concretes.

I. ASTM C642 - Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete.

J. ASTM C672 - Test Methods for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.

K. ASTM D395 - Standard Test Methods for Rubber Property - Compression Set.

L. ASTM D412 - Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.

M. ASTM D573 - Test Method for Rubber - Deterioration in an Air Oven.

N. ASTM D746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

O. ASTM D2240 - Test Method for Rubber Property - Durometer Hardness.

P. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

Q. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

R. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

S. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

T. NFPA 70 - National Electrical Code

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures”.

B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

C. Product Data: Provide manufacturers catalog data including load capacity.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable Codes for support of piping.

B. Supports for Electrical: In conformance with NFPA 70 and Division 26 of the Specifications.

PART 2 - PRODUCTS

2.1 HANGERS, SUPPORTS, & PIPE CLAMPS

A. Approved Manufacturers (first manufacturer is basis of design):
   1. Strut Hangers:
      a. Unistrut (division of Atkore).
      b. Anvil International.
      c. Cooper B-Line.
      d. Hydra-Zorb Company.
      e. Thomas & Betts - Superstrut line.
      f. Tolco (division of Eaton).
   2. Adjustable Swivel Band Hangers:
      a. Carpenter & Paterson.
      b. Anvil International.
      c. Cooper B-Line.
      d. Tolco (division of Eaton).
   3. Clevis Hangers:
      a. Cooper B-Line.
      b. Anvil International.
      c. Carpenter & Paterson.
      d. Tolco (division of Eaton).

4. J-Hangers:
   a. Cooper B-Line.
   b. Carpenter & Paterson.
   c. Thomas & Betts - Superstrut line.
   d. Tolco (division of Eaton).
   e. Unistrut (division of Atkore).
5. Cushion Clamps:
   a. Hydra-Zorb Company.
   b. Cooper B-Line.
   c. Thomas & Betts - Superstrut line.
   d. Tolco (division of Eaton).
   e. Unistrut (division of Atkore).
6. Insulated Pipe Couplings:
   a. Cooper B-Line - Armafix line.
   b. Klo-Shure Corporation.
7. No substitutions.

B. Horizontal Piping Supports: Provide struts for trapeze hangers for single or multiple pipes. Where individual piping runs are hung with individual hangers, adjustable swivel band hangers, clevis hangers, or j-hangers may be used.

C. Strut hangers shall be standard 1-5/8 inches x1-5/8 inches size.

D. Hangers, clamps, and supports located outdoors or otherwise exposed to weather, or in wet or washdown areas, shall be hot-dipped galvanized steel or 300-series stainless steel. Struts may be extruded aluminum. Threaded rods, nuts, and washers may have standard galvanizing if hot-dipped galvanized is not available.
   1. Hot-dipped galvanized steel shall have a nominal zinc coating of 2.6 mil thickness and 1.5 oz./sq.ft coating weight.
   2. In lieu of galvanizing, strut systems and their accessories may have Unistrut Perma-Green III electrodeposited thermoset acrylic coating, or be epoxy-coated equal to B-Line's Dura-Green or Dura-Copper coatings.
   3. Lesser coatings for struts and clamps, such as pre-galvanizing (0.75 mil thickness), electroplated zinc (0.2 to 0.5 mil thickness), and yellow zinc dichromate coating, are not acceptable in these locations.

E. Pipe hanger rods and nuts shall be plated to match the hangers. Nuts shall be self-locking type, or provide double nuts tightened to lock together. Rods shall be threaded one end, or continuous threaded. Provide washers at each nut.

F. Cushion Clamps for Un-insulated Lines: Plastic cushion shall be Dupont Hytel plastic, 5555HS plastic elastomer, warranted from -40 to 275 degrees F.

G. Copper-plated hangers are plated for identification only. Traditional thin copper plating on steel substrate does not provide adequate protection from galvanic corrosion due to contact between dissimilar metals.
   1. Where copper-plated supports are specified for use with copper piping, either copper plating or a copper-colored finish such as Cooper B-Line's Dura-Copper epoxy coating is acceptable. This is for identification, and does not protect dissimilar metals.

2. Where copper piping is used with steel hangers and supports, provide protection from galvanic corrosion such as thick plastic or vinyl factory coating, or plastic-lined cushion clamps.

H. For Insulated Lines Clamped to Strut: Insulated pipe coupling insert with the same thickness as the insulation. Protects insulation from crushing, and provides continuous insulation and vapor barrier thru the hanger or clamp. Klo-Shure product provides plastic pipe support and rigid outer band, for field insulation into the coupling. Armafix product provides insulation with rigid outer band, for field insulation glued to the ends of the insert.

2.2 PIPE SUPPORTS

A. Hydronic Piping:
1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
7. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
8. Wall Support for Cold Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
9. Vertical Support: Steel riser clamp.
10. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Floor Support for Hot Pipe Sizes to 4 inches : Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Floor Support for Hot Pipe Sizes 5 inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
13. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

B. Fuel Gas Piping:
1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Vertical Support: Steel riser clamp.

C. Refrigerant Piping:
1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch : Malleable iron, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 inches : Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and

concrete pier or steel support.

9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.3 INSERTS

A. Manufacturers:
1. Cooper B-Line.
2. Grinnell.

B. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 26 gauge thick galvanized steel.

B. Metal Counterflashing: 22 gauge thick galvanized steel.

C. Lead Flashing:
1. Waterproofing: 5 lb/sq ft sheet lead
2. Soundproofing: 1 lb/sq ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gauge thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge thick galvanized steel.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Sleeves for Round Ductwork: Galvanized steel.

E. Sleeves for Rectangular Ductwork: Galvanized steel.

F. Stuffing or Firestopping Insulation: Glass fiber type, non-combustible.

G. Sealant: Acrylic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support vertical piping at every floor.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Support riser piping independently of connected horizontal piping.

H. Provide copper plated hangers and supports for copper piping.

I. Design hangers for pipe movement without disengagement of supported pipe.

J. Prime coat exposed steel hangers and supports. Refer to Division 09 for painting. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

K. Do not support pipes from other pipes or equipment.

L. Size pipe hangers to accommodate continuous piping insulation.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment, with 1 inch chamfered edges. Provide dowels to fasten pad to structural floor. Refer to Division 03. Unless otherwise shown or specified, floor-mounted major equipment shall be set on housekeeping pads and anchored to housekeeping pads. This shall include but not be limited to, air handling units, ventilation units, boilers, and expansion tanks.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

E. Do not support equipment from pipes or from other equipment.

3.5 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weatherproofed or waterproofed walls, floors, and roofs.

B. Flash pipes projecting 3 inches minimum above finished roof surface with lead, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, counterflash with metal, and seal.

C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.7 SUPPORTING OTHER TRADES

A. Supports furnished under Division 23 of the Specifications may also be used to support piping furnished under Division 22 “Plumbing” and conduits furnished under Division 26 “Electrical” if this Subcontractor is willing to allow this. Supports shared with other trades shall be designed to accommodate the weight, expansion/contraction, vibration, and other requirements

of the other trades' items without detriment to the function, accessibility, and serviceability of the HVAC items or those of the other trades. Provide flexible sections of piping and conduit as required to allow each trade's items to expand and contract along with the other trades, and to absorb vibration caused by the other trades.

B. Electrical lighting fixtures and equipment, and architectural items such as ceilings, may not be supported from supports furnished under this Section.

C. Prevent contact between components of other trades, such as architectural suspended ceiling support wires, and HVAC supports which may transmit vibration to the occupied space.

3.8 SCHEDULES

PIPE SIZE		HANGER ROD MAX. HANGER SPACING		DIAMETER	
Inches	(mm)	Feet	(m)	Inches	(mm)
Steel and Copper Piping					
1/4 to 1-1/4	6 to 32	6.5	2	3/8	9
1-1/2 to 2	38 to 50	10	3	3/8	9
2-1/2 to 3	62 to 75	10	3	1/2	13
4 to 6	100 to 150	10	3	5/8	15
PVC (All Sizes)		6	1.8	3/8	9

END OF SECTION 230529

SECTION 230548 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vibration isolation.

1.2 RELATED SECTIONS

A. Division 03 Section “Cast-in-Place Concrete.”

B. Division 23 Section “Expansion Fittings and Loops for HVAC Piping.”

C. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

D. Division 26 Section “Electrical”: Electrical characteristics and wiring connections.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.4 PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated elsewhere in these specifications, provide vibration isolation on motor driven equipment over 0.5 HP (0.35 kW), plus connected piping and ductwork.

B. Provide Minimum Static Deflection of Isolators for Equipment as Indicated:
   1. Basement, Under 20 hp (15 kw)
      a. Under 400 rpm: 1 inch
      b. 400 - 600 rpm: 1 inch
      c. 600 - 800 rpm: 0.5 inch
      d. 800 - 900 rpm: 0.2 inch
      e. 1100 - 1500 rpm: 0.14 inch
      f. Over 1500 rpm: 0.1 inch
   2. Basement, Over 20 hp (15 kw)
      a. Under 400 rpm: 2 inch
      b. 400 - 600 rpm: 2 inch
      c. 600 - 800 rpm: 1 inch
      d. 800 - 900 rpm: 0.5 inch
      e. 1100 - 1500 rpm: 0.2 inch
      f. Over 1500 rpm: 0.15 inch
   3. Upper Floors, Normal
      a. Under 400 rpm: 3.5 inch
      b. 400 - 600 rpm: 3.5 inch

c. 600 - 800 rpm: 2 inch
d. 800 - 900 rpm: 1 inch
e. 1100 - 1500 rpm: 0.5 inch
f. Over 1500 rpm: 0.2 inch

4. Upper Floors, Critical
   a. Under 400 rpm: 3.5 inch
   b. 400 - 600 rpm: 3.5 inch
   c. 600 - 800 rpm: 3.5 inch
   d. 800 - 900 rpm: 2 inch
   e. 1100 - 1500 rpm: 1 inch
   f. Over 1500 rpm: 0.5 inch

C. Upper floor locations shall be considered critical unless otherwise indicated.

1.5 REQUIREMENTS

A. Outdoor Equipment: Provide restraint to withstand the force of a 100 mph wind applied to any exposed surface of the isolated equipment. Provide bolt holes for attachment to equipment and to supports.

1.6 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures”.

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

C. Product Data: Provide schedule of vibration isolator type with location and load on each. Indicate static deflection expected under the actual load, and minimum static deflection.

D. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

E. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures”.

B. Record actual locations of hangers including attachment points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Mason Industries, Inc.

B. Amber/Booth Co.

C. Kinetics Noise Control.

D. Korfund Dynamics Corp.

E. Vibration Eliminator Co.

F. Vibration Mountings and Controls, Inc.

2.2 GENERAL

A. Metal parts installed outdoors shall be corrosion resistant after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.

B. Isolator types are scheduled to establish minimum standards. At the Contractor's option, labor-saving devices may be an integral part of isolators, to provide initial lift of equipment to operating height, to hold piping at fixed elevations during installation and initial filling, and similar installation advantages. Accessories and seismic restraint features shall not degrade the isolation performance of the isolators.

C. Static deflections indicated are the minimum under actual load. Isolators selected solely on the basis of rated deflections are not acceptable.

2.3 VIBRATION ISOLATORS

A. Open Spring Isolators:
1. Spring Isolators:
   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

B. Restrained Spring Isolators:
1. Spring Isolators:
   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Provide with leveling devices, minimum 0.25 inchthick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
5. Restraint: Provide heavy mounting frame and limit stops.

C. Closed Spring Isolators:
   1. Spring Isolators:
      a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
      b. Code: Color code springs for load carrying capacity.
   2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
   3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
   4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

D. Restrained Closed Spring Isolators:
   1. Spring Isolators:
      a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
      b. Code: Color code springs for load carrying capacity.
   2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
   3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
   4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.

E. Spring Hanger:
   1. Spring Isolators:
      a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
      b. Code: Color code springs for load carrying capacity.
   2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
   3. Housings: Incorporate rubber hanger with threaded insert.
   4. Misalignment: Capable of 20 degree hanger rod misalignment.

F. Rubber Hanger:
   1. Mason Model HD.
   2. Construction: Double-deflection LDS (Low Dynamic Stiffness) bridge-bearing natural rubber or neoprene element, with projecting bushing to prevent steel-to-steel contact. Neoprene bonded to steel plates on top and bottom, with hole thru middle so that rod weight bears on top of element, putting element in compression when equipment weight is added. Steel housing with upper hole for rod.
   3. Field-furnished rods, nuts, and washers.
   4. Color code rubber or neoprene element for load carrying capacity.
   5. Deflection of 0.35 inches at maximum rated weight.

G. Neoprene Pad Isolators:
   1. Mason Model W, neoprene or nitrile rubber waffle pads.
      a. 40 durometer material stiffness rating, ASTM D2240 type A scale.
      b. Minimum 5/16 inch thick.

c. Recommended loading 60 psi.
d. Maximum loading 85 psi.
e. Height of ribs shall not exceed 0.7 times width.
f. Waffle ribs on 1/2 inch centers.
g. Approximately 15 percent deflection at recommended loading.
h. Provide higher durometer rating if higher loading is required.

2. Configuration: Single layer.

H. Rubber Mounts:
1. Mason Model ND.
2. Construction: Double-deflection oil-resistant neoprene or natural rubber element, with threaded steel insert, hex-head cap screw and washer. Neoprene bonded to steel plates on top and bottom, wrapping steel plates for corrosion protection. Weight bears on top of element, putting element in compression when equipment weight is added. Steel base plate has holes for bolting. Neoprene wrapping under bottom side of base plate and on top of top plate provides friction.
3. Color code neoprene or rubber element for load carrying capacity.
4. Deflection of at least 0.35 inches at maximum rated weight.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install isolation for motor driven equipment.

C. Bases:
1. Set steel bases for 1 inch clearance between housekeeping pad and base.
2. Adjust equipment level.

D. Bolt base-type spring or rubber mounts to the equipment. Bolt to the floor, concrete housekeeping pad, or other support base or frame indicated, unless otherwise indicated.

E. Install spring hangers without binding.

F. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

G. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

H. Support piping connections to isolated equipment (including equipment which is internally isolated at the factory) resiliently as follows:
1. Up to 4 Inch Diameter: First 3 points of support.
2. 5 to 8 Inch Diameter: First 4 points of support.
3. 10 inch Diameter and Over: First 6 points of support.
4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or

static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

I. Connect wiring to isolated equipment with flexible hanging loop.

J. Sheetmetal ducts and air plenums within mechanical rooms or within a distance of 50 feet total duct length of connected vibration isolated equipment (whichever is longer) (including equipment which is internally isolated at the factory) shall be isolated from the building structure by spring hangers.

K. Connect hanger rods for vibration isolated supports to structural beams or joists, not from the floor slab or roof deck between beams and joists. Provide intermediate support members as required.

L. Resiliently isolated pipes shall not contact the building construction or other equipment.

M. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer's requirements and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.

N. Unless otherwise indicated, there shall be a minimum operating clearance of 1-1/2 inch between steel frame bases and the floor beneath the equipment. Position isolator mounting brackets and adjust isolators so that the required clearance is maintained. Check the clearance space to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.

O. If any rotating equipment causes excessive noise or vibration when properly installed on the specified isolators, provide rebalancing, realignment, and/or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer’s specifications for the equipment.

3.2 MANUFACTURER'S FIELD SERVICES

A. Examine systems under provisions of Division 01 Section “Quality Requirements”.

B. Inspect isolated equipment after installation and submit report. Include static deflections.

EQUIPMENT ISOLATION SCHEDULE

ISOLATED EQUIPMENT	BASE Type Thickness	ISOLATOR Type Deflection
HVAC Pumps, Suspended	Pump Flange	Spring Hanger 1 inch
Blower Coil Units, Indoor Floor Mounted		Housed Spring 2 inch

Ducted Heat Pumps, Indoor Suspended		Rubber Hanger 0.35 inch
Dehumidifiers, Suspended		Spring Hanger 1 inch
Energy Recovery Ventilators, Outdoor	Metal Stand	Housed Spring 1 inch
Condensing Units Serving Blower Coils, Outdoor	Metal Stand	Rubber Mount 0.35 inch

END OF SECTION 230548

SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Labels.

D. Stencils.

E. Pipe Markers.

F. Lockout Devices.

1.2 RELATED SECTIONS

A. Division 09 Sections “Interior Painting” and “Exterior Painting”: Identification painting.

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.

B. ASME A13.1 - Scheme for the Identification of Piping Systems (2007 edition or newer).

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.4 SUBMITTALS

A. Division 01 Section “Submittal Procedures.”

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Samples: Submit two tags, 1-1/2 inches in size.

F. Samples: Submit two labels, 1.9 x 0.75 inches in size.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under Division 01 Section “Closeout Procedures.”

B. Record actual locations of tagged valves; include valve tag numbers.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Include valve tag chart.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:
1. Seton Identification Products.
2. E.R. Perry Signs & Engraving.
3. Brimar Industries, Inc., PipeMarker division.
4. No substitutions.

B. Plastic Nameplates: Laminated 3-layer plastic with beveled edges and engraved letters on contrasting background color, 1/16 inch thick. Letters shall be black on light backgrounds, or white on dark backgrounds, as applicable. Service temperature range -40 to 175 degrees F; minimum application temperature for adhesive 50 degrees F. Suitable for average outdoor lifespan of at least 2-3 years.

C. Aluminum Nameplates: For higher temperature applications, and for outdoor applications when manufacturer does not recommend their plastic nameplates for use outdoors, provide aluminum nameplates, with integral anodized or painted surface color coating and natural aluminum engraved letters, 1/32-inch thick. Service temperature range -40 to 350 degrees F; minimum application temperature for adhesive 50 degrees F. Suitable for average outdoor lifespan of at least 2-3 years.

D. Colors: Select background color as appropriate for the application. Color for general applications shall be white (except that aluminum nameplate standard color shall be black). Color for general warnings shall be red or yellow. Colors for fluid services shall comply with ASME A13.1-2007. Comply with ASME/ANSI standards and other regulations as applicable.

E. Provide with factory adhesive, and with side holes for fastener attachment as applicable. Mechanical fasteners are required for applications which are outdoors or otherwise exposed to weather or sunlight, or in moist areas such as kitchens and locker rooms, or on cooled surfaces subject to condensation, or on surfaces with operating temperatures above 150 degrees F. Where nameplate is on an irregular surface and cannot make complete contact, provide mechanical fasteners or ties in addition to adhesive.

2.2 TAGS

A. Plastic Tags:
1. Manufacturers:
a. Seton Identification Products.

b. E.R. Perry Signs & Engraving.
c. Brimar Industries, Inc., PipeMarker division.
d. No substitutions.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.

B. Metal Tags:
1. Manufacturers:
a. Seton Identification Products.
b. Brady Worldwide, Inc.
c. Brimar Industries, Inc., PipeMarker division.
d. No substitutions.
2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with smooth edges.

C. Information Tags:
1. Manufacturer: Seton Identification Products.
2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

D. Tag Chains and Hooks: Brass or stainless steel compatible with tag material for general applications. Brass where in contact with copper piping or other copper-alloy materials.

E. Tag Chart: Typewritten letter size list in anodized aluminum frame with plexiglass cover.

2.3 CEILING DOTS WITH LABEL-MAKER LABELS

A. Ceiling Dots:
1. Manufacturer: Avery – Division of Avery Dennison Corporation.
2. Description: Self-adhesive 1/2 inch diameter color coded label.

B. Label-Maker Labels:
1. Label Maker:
a. Manufacturer:
1) Brother.
2) Brady.
3) Dymo.
b. Label width capacity: Maximum tape width at least 3/4 inch.
c. Technology: Thermal transfer.
2. Labels:
a. Color:
1) Clear with black lettering for white or off-white ceiling grids.
2) White with black lettering for dark-colored or metallic-colored ceiling grids.
b. Width:
1) 3/4 inch for standard 15/16 inch wide ceiling grids.
2) 1/2 inch for narrow 9/16 inch wide ceiling grids.
c. Lettering Height: Maximum size available, for ease of viewing from floor. Typical sizes as follows:
1) 36 point (1/2 in.) on 3/4 inch wide labels.
2) 24 point (1/3 in.) on 1/2 inch wide labels.

C. At Contractor's option, label-maker labels with color-coded backgrounds may be used instead of separate dots and labels.

D. Color code as follows:
1. HVAC Equipment: Yellow.
2. Fire Dampers/Smoke Dampers: Red.
3. Plumbing Valves: Green.
4. Heating/Cooling Valves: Blue.

2.4 LABELS

A. Manufacturer: Seton Identification Products.

B. Description: Polyester, size 1.9 x 0.75 inches, adhesive backed with printed identification.

2.5 STENCILS

A. Manufacturers:
1. Seton Identification Products.
2. Brimar Industries, Inc., PipeMarker division.

B. Stencils: With clean cut symbols and letters of following size:
1. Up to 2 inch Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1 inch high letters.
3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
4. Ductwork and Equipment: 1-3/4 inches high letters.

C. Stencil Paint: As specified in Division 09 Sections "Interior Painting" and "Exterior Painting", semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.6 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:
1. Manufacturers:
a. Seton Identification Products.
b. Brady Worldwide, Inc.
c. Brimar Industries, Inc., PipeMarker division.
d. No substitutions.
2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:
1. Manufacturers:
a. Seton Identification Products.
b. Brady Worldwide, Inc.

c. Master Lock.

2. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:
   a. Seton Identification Products.
   b. Brady Worldwide, Inc.
   c. Master Lock.
2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Division 09 Sections “Interior Painting” and “Exterior Painting” for stencil painting.

3.2 INSTALLATION

A. Division 01 Section “Quality Requirements”: Manufacturer's instructions.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic or aluminum engraved nameplates with corrosion-resistant mechanical fasteners, or adhesive, as specified. In outdoor locations, where lifetime of nameplates is limited, fasteners shall be removable screws or bolts for ease of nameplate replacement.

D. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Apply stencil painting in accordance with Division 09 Sections “Interior Painting” and “Exterior Painting.”

G. Identify items of mechanical equipment such as fans, terminal units, air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

H. Identify control panels and major control components outside panels with plastic nameplates.

I. Identify valves in main and branch piping with metal tags.

J. Tag automatic controls, instruments, and relays. Key to control schematic.

K. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch

diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, at each branch and riser take-off, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

L. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

M. Identify duct access doors at fire dampers, smoke dampers, and smoke detectors with 1/2 inch lettering to indicate the fire protection device(s) within, in accordance with NFPA 90A.

N. Provide ceiling dots with label-maker labels to locate valves, dampers and equipment above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

O. Secure valve tag chart on an easily accessible wall in the mechanical room or in a location as otherwise directed by the Architect.

3.3 COORDINATION WITH EXISTING EQUIPMENT

A. Where an existing equipment identification system is involved, the new system shall be coordinated and compatible with the existing system.

END OF SECTION 230553

SECTION 230593 – TESTING, ADJUSTING, AND BALANCING FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, Adjustment, and Balancing of Air Systems.

B. Testing, Adjustment, and Balancing of Hydronic, Refrigeration, and Plumbing Drain Pump Piping Systems.

C. Measurement of Final Operating Condition of HVAC Systems.

D. Sound Measurement of Equipment Operating Conditions.

1.2 RELATED SECTIONS

A. Division 01 Section “Quality Requirements”: Testing laboratory services: Employment of testing agency and payment for services.

B. Division 01 Section “General Commissioning Requirements.”

1.3 REFERENCES

A. AABC - National Standards for Total System Balance.

B. ADC - Test Code for Grilles, Registers, and Diffusers.

C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers.

C. NEBB: National Environmental Balancing Bureau.

D. SMACNA: Sheet Metal and Air Conditioning Contractors’ National Association.

E. TAB: Testing, Adjusting, and Balancing.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Submit name of TAB Agency for approval within 14 days after award of Contract.

C. Design Review Reports:
1. Submit prior to commencement of construction under provisions of Division 01 Section “Quality Requirements.”
2. Review the Contract Documents, and indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

D. Preliminary Report Submittals:
1. Prior to commencing work of this Section, and no more than 14 days after approval of TAB Agency submittals, submit report forms or outlines indicating adjusting, balancing, and equipment data required, with columns of design data filled in. By means of plan views, equipment profiles, and similar graphical descriptions, indicate where measurements will be taken.
2. Submit the procedures to be used.

E. Field Reports: Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

F. Provide reports in letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

G. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.

H. Test Reports: Indicate data on AABC National Standards for Total System Balance forms, or forms prepared following ASHRAE 111, or NEBB forms, or forms containing information indicated in Schedules.

1.6 QUALITY ASSURANCE

A. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance; or ASHRAE 111; or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.7 QUALIFICATIONS

A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum 3 years’ experience and certified by AABC or NEBB, or equivalent experience which would qualify for membership in these testing organizations.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer, NEBB

Certified Testing, Balancing and Adjusting Supervisor, or licensed Professional Engineer experienced in performance of this Work and licensed at the place where the Project is located.

C. The approved Agency shall be in no way affiliated with the installing Subcontractor.

1.8 SEQUENCING

A. Sequence work under the provisions of Division 01 Section “Summary.”

B. Sequence work to commence after completion of systems or portions of work, and schedule completion of work before Substantial Completion of Project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that systems are complete and operating correctly in accordance with sequence of operations before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Submit field reports. Report to the responsible Subcontractors, defects and deficiencies noted during performance of services which prevent system balance. Submit list of locations where the Contractor needs to provide additional balancing devices.

C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross-sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

G. Provide system schematic (in floor-plan or line-diagram view) with outlets and inlets numbered with the reference numbers used in the TAB Agent’s tabular data, and with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including pressure drops across filters, coils, dampers, mixing boxes, and heat recovery devices, and total pressure across the

fan. Make allowances for 50 percent loading of filters, and indicate actual filter drop as well as the allowances. Provide equipment diagram indicating internal components and measurement points.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Adjust at minimum position and maximum position, and use manual dampers and actuator limit stops to minimize differences.

J. Where modulating dampers are provided, take measurements and balance at extreme conditions.

K. Set pattern-control vanes and other devices in air inlets and outlets to provide the spread and throw patterns indicated, without objectionable noise or air motion to the occupants. Split the flow of linear slot diffusers in directions as required for good coverage. At completion, patterns shall be uniform and pleasing to the eye.

3.6 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing.

F. Where available pump capacity is less than total flow requirements of individual system parts (due to system diversity), full flow in one part may be simulated by temporary restriction of flow to other parts.

G. Coordinate with Division 23 Section “Instrumentation and Controls for Mechanical Systems” for calibration of pump static pressure sensors and determination of pressure setpoints.

H. When the available pump head is more than 15 percent above the required head to meet the design flow, adjust pump speed or trim the pump impeller to bring the head within 100 to 110 percent of the required head to meet the design flow. At least one balancing valve in the system, and one balancing valve per each multi-circuit sub-main branch served by a branch balancing valve, shall be fully open when balancing is complete.

3.7 REFRIGERATION TESTING PROCEDURES

A. Obtain information from the refrigeration unit startup technician, including refrigerant and oil

types and quantities used, and saturated suction temperature at full-load operation. Record this information for each refrigeration circuit.

B. Record condenser inlet and outlet air temperatures at full load for each refrigeration circuit individually, and for unit full load with all circuits running. Provide heat at the cooling coil, and adjust operating room or air temperature setpoints, as required to simulate full load conditions. If testing is done on heat pump systems during heating season and cooling is unavailable, simulate full load heating conditions instead of cooling conditions.

3.8 SOUND TEST PROCEDURES

A. Application: Special Collections rooms.

B. Timing: Take sound level measurements at times when the building is unoccupied, or when activity in surrounding areas and background noise levels in areas tested are at minimum and relatively free from sudden changes in noise levels. Take measurements with equipment secured, except that being tested. Measure sound levels at any point within a room not less than 6 feet from an air terminal or room unit, and not closer than 3 feet from any floor, wall, or ceiling surface.

C. Measure, record and submit sound power levels in each space listed below. If levels exceed values listed below, identify and eliminate mechanical system deficiencies which are the source of the noise at no additional cost to the Owner.

Room Type	NC
1. Conference rooms	25 - 30
2. Special Collections Storage and B07 Basement	30 - 35
3. Special Collections	40 - 45

3.9 COORDINATION OF SERVICES

A. The General Contractor and his Subcontractors shall be responsible for providing the following assistance to the TAB Agent:
   1. Provide access to the Contractor’s on site ladders and man-lifts as required to allow access to required equipment by the TAB Agent.
   2. Keep the TAB Agent informed of the project schedule and ensure that adequate notice is given to the TAB Agent to allow for the proper testing, adjusting and balancing of mechanical systems before ceilings are flooded or access to systems is otherwise obstructed.
   3. Ensure that adequate time is allotted in the project schedule to allow for the proper testing, adjusting and balancing of the mechanical systems.
   4. Coordinate with the TAB Agent to correct system deficiencies that are discovered by the TAB Agent. Notify the TAB Agent once system deficiencies are corrected.

3.10 PROJECT CLOSEOUT

A. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Architect.

B. Check and adjust systems approximately 6 months after final acceptance and submit report.

C. Retests: If random tests elicit a measured flow deviation of 10 percent or more from, or a sound level of 2 dB or more, greater than, that recorded in the certified report listings, at 10 percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made.

3.11 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:
1. Plumbing Pumps
2. HVAC Pumps
3. Boilers
4. Air Cooled Refrigerant Condensing Units
5. Split System Air Conditioning Units
6. Split System Heat Pump Units
7. Air Coils
8. Terminal Heat Transfer Units
9. Energy Recovery Units
10. Terminal Heating and Cooling Units
11. Blower Coils
12. Fans
13. Air Filters
14. Air Inlets and Outlets

B. Report Forms:
1. Title Page:
   a. Name of Testing, Adjusting, and Balancing Agency
   b. Address of Testing, Adjusting, and Balancing Agency
   c. Telephone number of Testing, Adjusting, and Balancing Agency
   d. Project name
   e. Project location
   f. Project Architect
   g. Project Engineer
   h. Project Contractor
   i. Project altitude
   j. Report date
2. Summary Comments:
   a. Design versus final performance
   b. Notable characteristics of system
   c. Description of systems operation sequence
   d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
   e. Nomenclature used throughout report
   f. Test conditions
3. Instrument List:
   a. Instrument
   b. Manufacturer

c. Model number
d. Serial number
e. Range
f. Calibration date

4. Electric Motors:
   a. Manufacturer
   b. Model/Frame
   c. HP/BHP
   d. Phase, voltage, amperage; nameplate, actual, no load
   e. RPM
   f. Speed setting
   g. Service factor
   h. Starter size, rating, heater elements
   i. Sheave Make/Size/Bore
5. Pump Data:
   a. Identification/number
   b. Manufacturer
   c. Size/model
   d. Impeller
   e. Service
   f. Design flow rate, pressure drop, BHP
   g. Actual flow rate, pressure drop, BHP
   h. Discharge pressure
   i. Suction pressure
   j. Total operating head pressure
   k. Shut off, discharge and suction pressures
   l. Shut off, total head pressure
6. Combustion Test:
   a. Boiler manufacturer
   b. Model number
   c. Serial number
   d. Fuel type
   e. Firing rate
   f. Overfire draft
   g. Gas pressure at meter outlet
   h. Gas flow rate
   i. Heat input
   j. Burner manifold gas pressure
   k. Percent carbon monoxide (CO_2)
   l. Percent carbon dioxide (CO_2)
   m. Percent oxygen (O_2)
   n. Percent excess air
   o. Flue gas temperature at outlet
   p. Ambient temperature
   q. Net stack temperature
   r. Percent stack loss
   s. Percent combustion efficiency
   t. Heat output

7. Air Cooled Condensing Unit:
    a. Identification/number
    b. Location
    c. Manufacturer and Model number
    d. Serial number
    e. Entering DB air temperature, design and actual
    f. Leaving DB air temperature, design and actual
    g. Number of compressors
    h. Refrigerant and oil types and quantities
8. Cooling Coil Data:
    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Rows, and fins per inch
    f. Air flow, design and actual
    g. Entering air DB temperature, design and actual
    h. Entering air WB temperature, design and actual
    i. Leaving air DB temperature, design and actual
    j. Leaving air WB temperature, design and actual
    k. Refrigerant saturated suction temperature, design and actual
    l. Refrigerant superheat temperature
    m. Air pressure drop, design and actual
9. Heating Coil Data:
    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Rows, and fins per inch
    f. Air flow, design and actual
    g. Water flow, design and actual
    h. Water pressure drop, design and actual
    i. Entering water temperature, design and actual
    j. Leaving water temperature, design and actual
    k. Entering air temperature, design and actual
    l. Leaving air temperature, design and actual
    m. Air pressure drop, design and actual
10. Water Distribution Test Sheet:
    a. Water terminal unit number
    b. Room number/location
    c. Terminal unit type
    d. Water flow, design and actual
    e. Water pressure drop, design and actual
    f. Fan speed setting, design and actual
11. Air Moving Equipment:
    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number

e. Arrangement/Class/Discharge
f. Air flow, specified and actual
g. Return air flow, specified and actual
h. Outside air flow, specified and actual
i. Total static pressure (total external), specified and actual
j. Inlet pressure
k. Discharge pressure
l. Component pressure drops
m. Fan speed settings
n. Fan RPM

12. Return Air/Outside Air Data:
    a. Identification/location
    b. Design air flow
    c. Actual air flow
    d. Design return air flow
    e. Actual return air flow
    f. Design outside air flow
    g. Actual outside air flow
    h. Return air temperature
    i. Outside air temperature
    j. Required mixed air temperature
    k. Actual mixed air temperature
    l. Design outside/return air ratio
    m. Actual outside/return air ratio
13. Exhaust Fan Data:
    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Air flow, specified and actual
    f. Total static pressure (total external), specified and actual
    g. Inlet pressure
    h. Discharge pressure
    i. Fan RPM
14. Duct Traverse:
    a. System zone/branch
    b. Duct size
    c. Area
    d. Design velocity
    e. Design air flow
    f. Test velocity
    g. Test air flow
    h. Duct static pressure
    i. Air temperature
    j. Air correction factor
15. Air Distribution Test Sheet:
    a. Air terminal number
    b. Room number/location
    c. Terminal type

d. Terminal size
e. Area factor
f. Design velocity
g. Design air flow
h. Test (final) velocity
i. Test (final) air flow
j. Percent of design air flow

16. Sound Level Report:
    a. Location
    b. Octave bands - equipment off
    c. Octave bands - equipment on

END OF SECTION 230593

SECTION 230713 – DUCT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductwork Insulation.

B. Duct Liner.

C. Sound Lagging Insulation.

D. Insulation jackets.

1.2 RELATED SECTIONS

A. Division 07 Section “Self-Adhering Sheet Waterproofing”: Installation and finishing of outdoor insulation jacket.

B. Division 07 Section “Ethylene-Propylene-Diene-Monomer (EPDM) Roofing.”

C. Division 09 Section “Painting”: Painting insulation jackets.

D. Division 23 Section “Identification for HVAC Piping and Equipment.”

E. Division 23 Section “Metal Ducts”: Factory-insulated flexible ductwork.

F. Division 23 Section “Metal Ducts”: Ductwork.

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.

D. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.

E. ASTM C356 - Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.

F. ASTM C411 - Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation.

G. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

H. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

I. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

J. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

K. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

L. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation.

M. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).

N. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.

O. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

P. ASTM C1482 - Standard Specification for Polyimide Flexible Cellular Thermal and Sound Absorbing Insulation.

Q. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

R. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.

S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

T. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

U. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

V. ASTM E119 (UL 263) - Standard Test Methods for Fire Tests of Building Construction and Materials.

W. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

X. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

Y. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

Z. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

AA. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

BB. ISO 6944 - 1985 - Fire Resistance Tests - Ventilation Ducts.

CC. NAIMA - National Insulation Standards.

DD. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

EE. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

FF. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

GG. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

HH. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Division 01 Section “Submittal Procedures”.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS

A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches (50 mm).

B. Insulation materials shall be asbestos free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical

damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.

B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

C. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass and Mineral Fiber Products:
1. Knauf Insulation.
2. Certainteed Corporation.
3. Johns Manville.
4. Owens Corning.
5. No substitutions.

B. Elastomeric Foam Products:
1. Armacell LLC.
2. K-Flex USA.
3. Aeroflex USA, Inc.
4. No substitutions.

C. Polyisocyanurate Foam Board Products:
1. The Dow Chemical Company.
2. Atlas Roofing Corporation.
3. Johns Manville.
4. Rmax, Inc.

D. Sound Lagging Insulation:
1. Sound Seal - Industrial Division Lag Series.

E. Glass Fiber Insulation Sealing Tapes:
1. Venture Tape Corporation.
2. 3M Company.
3. Ideal Tape Co., division of American Biltrite Inc.
4. Nashua Tape Products, division of Berry Plastics Corp.
5. No substitutions.

F. Accessories:
1. Ceel-Co division of Johns Manville (product: plastic jacket systems).
2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B.

Fuller (mastics, sealants, reinforcing membranes, and accessories).
3. GLT Products (product: PVC corner angles).
4. Johns Manville (products: Super-Seal acrylic polymer coatings, Zeston plastic jacket systems).
5. Pabco/Childers Metals, division of ITW Insulation Systems (products: metal jacket systems, and accessories).
6. Vac Systems International (product: Tough Coat acrylic polymer mechanical insulation repair coating).
7. Venture Tape Corporation (product: Jacket for outdoor insulation).

2.2 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553; flexible, noncombustible blanket.
1. 'K' ('Ksi') value: ASTM C518, 0.27 at 75 degrees F.
2. Maximum service temperature: 250 degrees F faced and 350 degrees F unfaced.
3. Maximum moisture absorption: 0.20 percent by volume.
4. Minimum density: 1.0 lb/cu. ft..

B. Vapor Barrier Jacket:
1. ASTM C1136, Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier film. Facing as required for the application. Integral staple flap on one edge.
a. Aluminum Faced: FSK (aluminum foil-scrim-kraft) construction.
b. White Faced: PSK (polypropylene-scrim-kraft) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150 degrees F.
4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.

C. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

D. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

E. Tie Wire: Annealed steel, 16 ga.

2.3 GLASS FIBER, RIGID

A. Insulation: ASTM C612; rigid, noncombustible blanket. Supplied in board form.
1. 'K' ('Ksi') value: ASTM C518, 0.24 at 75 degrees F.
2. Maximum service temperature: 450 degrees F.
3. Maximum moisture absorption: 1.0 percent by volume.
4. Density: 3.0 lb/cu. ft..

B. Vapor Barrier Jacket:
1. ASTM C1136, kraft paper reinforced with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
a. Aluminum Faced: FSK (foil-scrim-kraft) construction
b. White Faced: ASJ (all-service jacket) construction.

2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150 degrees F.
4. Overlap longitudinal laps and butt strips.
5. Secure insulation with mechanical fasteners to substrate, and seal jacket with pressure sensitive tape.

C. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

D. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.4 GLASS FIBER, SEMI-RIGID

A. Insulation: ASTM C612; semi-rigid, noncombustible blanket, with fibers oriented perpendicular to insulation surface to provide compressive strength while maintaining flexibility. Supplied in roll form, suitable for application on rounded shapes such as pipes, tanks, ducts, vessels, and other similar round and irregular shapes.
1. 'K' ('Ksi') value: ASTM C518, 0.24 at 75 degrees F.
2. Maximum service temperature: 450 degrees F.
3. Maximum moisture absorption: 1.0 percent by volume.
4. Density: 2.5 lb/cu. ft..

B. Vapor Barrier Jacket:
1. ASTM C1136, kraft paper with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
   a. Aluminum Faced: FSK (foil-scrim-kraft) construction
   b. White Faced: ASJ (all-service jacket) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150 degrees F.
4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.

C. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

D. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.5 GLASS FIBER, PREFORMED PIPE COVERING

A. Insulation: ASTM C547; rigid molded, noncombustible.
1. 'K' ('Ksi') value: ASTM C177, 0.24 Btu-in/(hr-sq.ft-°F) at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket:
1. ASTM C1136, White kraft paper with glass fiber yarn, bonded to aluminized film.

2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Vapor Barrier Tape: Provide self-adhesive butt strips furnished by the insulation manufacturer, with finish to match the insulation outer finish.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.

H. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

I. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

J. Insulating Cement: ASTM C449/C449M.

2.6 GLASS FIBER INSULATION SEALING TAPE

A. Self-adhesive tape with integral vapor barrier, pressure sensitive acrylic-based or rubber-based adhesive, and release liner strip. Width 3 inch nominal.

B. Manufactured by VentureTape, by the insulation manufacturer, or by one of the other tape manufacturers listed in the article “Manufacturers” in this Section.

C. Types:
1. For rigid and semi-rigid insulations, tape shall be reinforced type. For flexible “duct wrap” insulation, tape shall be either reinforced or non-reinforced.
2. White or aluminum outer surface to match the insulation.
3. Reinforced: Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier layer.
   a. Aluminum Finish with FSK: VentureTape 1525CW.
   b. White Finish with ASJ: VentureTape 1540CW
   c. White Finish with PSK: VentureTape 1531CW.
4. Non-Reinforced: Foil insulation tape. Dead-soft temper 2 mil thick aluminum foil, without reinforcement. Hand-tearable.
   a. Venture Tape 3520CW.
5. Performance:
   a. Peel Adhesion: PSTC-101 with 20 minute dwell, 45 oz/in..
   b. Shear Adhesion: PSTC-107, 2.2 psi after 24 hours.
   c. Tensile Strength: PSTC-131:
      1) Reinforced Types: 40 lb/in..
      2) Non-reinforced Types: 21 lb/in..

d. Elongation: PSTC 131, 6 percent maximum.
e. Service Temperature: -40 to 240 degrees F.
f. UL 723 listed or classified (flame/smoke rating).

2.7 ELASTOMERIC FOAM

A. Approved Products:
1. Armacell: AP Armaflex and AP Armaflex FS sheet insulation.
2. K-Flex USA: Insul-Sheet S2S and K-Flex LS sheet insulation.

B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
1. 'K' ('Ksi') value: ASTM C177; 0.277 Btu-in/(h-ft2-degreesF) at 75 degrees F.
2. Minimum service temperature: -70 degrees F (flexible to -40 degrees F).
3. Maximum service temperature: 220 degrees F.
4. Maximum moisture absorption: ASTM C209, 0.2 percent by volume; or ASTM D1056, 5 percent by weight.
5. Moisture vapor transmission: ASTM E96; 0.08 perm-inches.
6. Connection: Waterproof vapor barrier adhesive.
7. Density: 3.0 to 6.0 lb/cu ft.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.8 POLYISOCYANURATE FOAM BOARD FOR OUTDOOR USE

A. General: Due to its high flame/smoke ratings, polyisocyanurate foam board may only be used outdoors, which means outside the building envelope and includes above roofs. It must be protected from weather with a watertight, UV-resistant jacketing or membrane system as specified. It must be protected from exposure to fire hazards indoors with continuous building construction such as metal roof deck, sealed smoke-tight, and in accordance with the manufacturer’s requirements. The duct must be fire-resistant metal (galvanized steel or stainless steel), and must be sealed airtight before insulating.

B. Approved Products:
1. Dow Chemical Co.: Thermax Heavy-Duty.
2. Atlas Roofing: ACFoam Supreme.
3. RMax: Thermasheath.

C. Insulation: ASTM C 1289, Type I, Class 2, foil-faced, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
1. 'K' ('Ksi') value: ASTM C518; 0.169 Btu-in/(h-ft2-degreesF) at 75 degrees F.
2. Minimum service temperature: -40 degrees F.
3. Maximum service temperature: 200 degrees F.
4. Maximum moisture absorption: ASTM C209, 1 percent by volume.
5. Moisture vapor transmission: ASTM E96; 1.0 perm.
6. Connection: Waterproof adhesive.
7. Density: ASTM D1622, 2.0 lb/cu. ft..
8. Compressive Strength: 25 psi at 10 percent deformation.
9. Accessories:
a. Tape: Reinforced peel-and-stick self-adhesive vapor barrier tape.

b. Fastening Pins: Cupped head type with no protruding points, may be welded or bonded with field-applied adhesive. Self-adhesive peel-and-stick type is not allowed.

D. Nailer Board: Provide insulation with integral factory-applied nailer board such as OSB on outer face.

E. Jacket: EPDM membrane conforming to the materials, thickness, and installation requirements of Section 07 53 23 Ethylene-Propylene-Diene-Monomer (EPDM) Roofing. Overlap seams to shed water downward.

2.9 GLASS FIBER DUCT LINER, RIGID BOARD

A. Insulation: ASTM C612; rigid, noncombustible board with acrylic polymer impregnated surface and edge coat meeting ASTM G21.
1. 'K' ('Ksi') value, ASTM C1071 or ASTM C518: Maximum 0.23 at 75 degrees F.
2. Maximum service temperature: 250 degrees F.
3. Maximum velocity on coated air side: 5,000 fpm.
4. Density: 3.0 lb/cu. ft.
5. Minimum sound absorption coefficients, ASTM C423, Type A mounting:
a. 250 Hz center band frequency: 0.24 for 1 inch thickness, 0.41 for 1-1/2 inches thickness, 0.67 for 2 inch thickness.
b. 500 Hz center band frequency: 0.56 for 1 inch thickness, 0.89 for 1-1/2 inches thickness, 1.07 for 2 inch thickness.
c. NRC: 0.65 for 1 inch thickness.

B. Adhesive: Waterproof, ASTM E162 fire-retardant type.

C. Liner Fasteners: Galvanized steel, self-adhesive pad with press-on head.

2.10 SOUND LAGGING INSULATION

A. Acoustical lagging and thermal insulation, in blanket form shipped in rolls, consisting of a loaded vinyl noise barrier with a scrim-reinforced aluminum foil vapor retarder facing on one side, with a quilted fiberglass decoupler. Service temperatures: -10 to 180 degrees F for outer lag layer, -20 to 350 degrees F for decoupler layer. Thermal insulation values: R-factor 1.0 h-ft2-degrees F/Btu for outer lag layer, 4.0 h-ft2- degrees F/Btu-inch for decoupler layer. Passes UL-94. Class A flame/smoke rating 25/50 or better per ASTM E-84.

B. Model B-20 LAG/QFA-3: Sound transmission class (STC) 32 per ASTM E90, 2 lb/sq.ft lag layer, 0.2 lb/sq.ft decoupler layer, 0.23-inch thick lag layer, 1-inch nominal thickness decoupler layer.

C. Model B-20 LAG/QFA-9: Sound transmission class (STC) 34 per ASTM E90, 2 lb/sq.ft lag layer, 0.4 lb/sq.ft decoupler layer, 0.23-inch thick lag layer, 2-inch nominal thickness decoupler layer.

D. Provide matching lag tape.

2.11 CORNER ANGLES

A. Preformed reinforced 90-degree angle shapes, of PVC plastic, or aluminum or galvanized steel, to protect outer corners of insulation.

2.12 ALUMINUM JACKET

A. ASTM B209.
1. Thickness: 0.032 inch sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.032 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.032 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section “Project Management and Coordination”: Verification of existing conditions before starting work.

B. Verify that ductwork has been tested before applying insulation materials.

C. Verify that surfaces are clean, foreign material removed, and dry.

D. Verify that insulation materials are clean and dry. Discard any materials that exhibit signs of moisture damage, contamination, mold, mildew, or other biological growth. Discard any materials used in the air handling airstream if they have been exposed to water.

3.2 INSTALLATION

A. Division 01 Section “Quality Requirements”: Manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Provide insulation for surfaces of ductwork, as indicated and specified. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2010, State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.

D. Insulated Ductwork Conveying Air below Ambient Temperature:
1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

E. Insulated Ductwork Conveying Air above Ambient Temperature:
1. Provide with or without standard vapor barrier jacket.

2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

F. Ductwork Exposed below 10 feet above finished floor in basements and Mechanical Equipment Rooms or below 8 feet above finished floor in Finished Spaces: Provide glass fiber rigid insulation with vapor barrier jacket.

G. Ductwork exposed below 8 feet above finished floor 105 Mechanical Room, and in Storage and File Rooms: Provide aluminum jacket over insulation.

H. On ductwork which is acoustically lined, provide outer insulation as scheduled.

I. Do not insulate exposed heating or cooling supply ductwork in the conditioned spaces which it serves, unless otherwise specified or indicated on the Drawings.

J. Wherever exposed ductwork for air conditioned systems passes through non air conditioned spaces, insulate ductwork with glass fiber rigid insulation with vapor barrier, to prevent condensation.

K. Where rigid glass fiber insulation is scheduled, semi-rigid glass fiber insulation may be used on round and flat oval ducts and irregular shapes, and preformed pipe insulation may be used on small diameter round ducts.

L. External Duct Insulation Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
6. Provide corner angles on insulation exposed to view less than 8 feet above finished floor, in 105 Mechanical room, Storage and File rooms, and in occupied spaces.

M. Duct and Plenum Liner Application:
1. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
2. Provide duct liner where:
   a. Indicated on the Drawings.
   b. Specified.
3. Install duct liner in accordance with SMACNA standards.
4. Adhesive: Apply to duct sheet metal for 90 percent coverage. Clean the duct before applying adhesive.
5. Mechanical Fastening: In addition to adhesive, provide mechanical fastening devices meeting the following requirements:
   a. Are spaced in accordance with SMACNA Standards and Manufacturer's recommendations.

b. When installed, are as corrosion-resistant as G60 coated galvanized steel.
c. Will not adversely affect the fire-resistant classification of liner and adhesives.
d. Do not damage the liner when applied as recommended by the manufacturer.
e. Do not cause leakage in the duct.
f. Do not project more than nominally into the airstream.
g. Will indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.
h. Have a permanent, waterproof bond to the duct wall.
i. Are the correct length for the specified liner thickness.

6. Seal and smooth liner airstream surface penetrations, cuts, tears, edges, and transverse and longitudinal joints with adhesive or acrylic polymer repair coating, compatible with liner surface coating.
7. Corners: Cut and fit liner in the corners of rectangular duct sections to assure butted edge overlapping. Longitudinal joints in duct liner shall not occur except at the corners of ducts unless the size of the duct and standard liner product dimensions make joints necessary.
8. Transverse Joints: Butt liner neatly without gaps.
9. Provide securely-installed metal nosings that are either channel or zee profile or are integrally-formed from the duct wall over transversely oriented liner edges facing the airstream at fan discharge, at access doors, and at any interval of lined duct preceded by unlined duct. In addition, where velocities exceed 2,000 fpm, provide metal nosing on upstream edges of liner at every transverse joint.
10. For edges of lining exposed to the airstream that are not protected by metal nosings, coat with adhesive or acrylic polymer repair coating. Cover raw insulation such that no fibers are released.
11. Where dampers, turning vane assemblies or other devices are placed inside of lined duct or fittings, install to not damage the liner or cause erosion of the liner. The use of metal hat sections or other buildout means is optional; when used, secure buildouts to the duct wall with bolts, screws, rivets or welds.
12. Do not install duct liner in fresh air intake ductwork between the outside intake opening and the fan or other air moving device, or within 10 feet (3 m) downstream of a cooling coil or humidifier.

N. Inspection Plates and Test Holes: Provide, where required, in ductwork or casings for balance measurements. Test holes shall be factory fabricated, airtight, and noncorrosive with screw cap and gasket. Extend cap through insulation.

O. Install insulation after ductwork and equipment have been tested and approved.

P. Ensure that surface is clean and dry prior to installation. Ensure that insulation is dry before and during application. Finish with system at operating conditions.

Q. Ensure that insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation material, properly sealed.

R. Finish insulation neatly at hangers, supports and other protrusions.

S. Locate insulation or cover seams in least visible locations.

T. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

U. Standing seams, supporting angles and flanges on insulated ductwork shall be insulated with thickness equal to the duct and edges shall be finished and vapor sealed.

V. For supply or return ductwork which is required to be insulated, insulation shall be continuous and shall include the insulating of register, grille and diffuser connection plenums/boots.

W. Mechanical fasteners shall not be riveted or screwed to the duct and shall not penetrate the metalwork.

3.3 PAINTING AND IDENTIFICATION

A. Paint in accordance with Division 09 Sections “Interior Painting” and “Exterior Painting.”

3.4 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to Specifications. Inspect installations progressively for compliance with requirements.

TABLE I
DUCTWORK INSULATION MATERIAL AND WALL THICKNESS

DUCTWORK TYPE	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS
Energy Recovery Ventilator ductwork outdoors (also lined as noted below)	Polyisocyanurate Foam Board, nailer board, EPDM jacket	Yes	2 inches
Energy Recovery Ventilator ductwork outdoors	Glass Fiber Duct Liner, Rigid	--	1 inch
Energy Recovery Ventilator ductwork from exterior building penetrations by ductwork to 6 feet interior of motorized damper and 4 feet interior of duct coils	Glass Fiber, Rigid, with Sound Lagging	Yes	2 inches
Exhaust ductwork from exterior building openings to dehumidifiers	Glass Fiber, Rigid	Yes	1-1/2 inches
Dehumidifier process and reactivation ductwork	Glass Fiber, Rigid	Yes	1-1/2 inches
Supply and Return ductwork serving blower coils, outside the Special Collections room and through the partition	Glass Fiber, Rigid	Yes	1-1/2 inches
Supply and Return ductwork serving blower coils, inside the Special Collections room	None	-	-
Supply ductwork for heat pumps	Glass Fiber, Flexible	No	2 inches

Outside air intake ductwork	Glass Fiber, Rigid	Yes	2 inches

END OF SECTION 230713

SECTION 230716 – HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment insulation.

B. Covering.

C. Shields, Inserts, and Saddles.

1.2 RELATED SECTIONS

A. Division 09 Sections “Interior Painting” and “Exterior Painting”: Painting insulation covering.

B. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”: Placement of hangers and hanger inserts.

C. Division 23 Section “Identification for HVAC Piping and Equipment.”

D. Division 23 Section “Heat Exchangers for HVAC”.

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.

B. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulation Cement.

F. ASTM C335 / C335M - Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.

G. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

H. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

I. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

J. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

K. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

L. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).

M. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

N. ASTM C1104 – Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.

O. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

P. ASTM C1511 - Standard Test Method for Determining the Water Retention (Repellency) Characteristics of Glass Fiber Insulation (Aircraft Type).

Q. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

S. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

T. NAIMA National Insulation Standards.

U. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

V. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Division 01 Section “Submittal Procedures.”

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches.

B. Insulation materials and accessories shall be asbestos-free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.

B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

C. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass and Mineral Fiber Products:
1. Knauf Insulation.
2. Certainteed Corporation.
3. Johns Manville.
4. Owens Corning.
5. No substitutions.

B. Hydrous Calcium Silicate Products:
1. IIG Industrial Insulation Group LLC, a Calsilite/Johns Manville joint venture. Thermo-12 Gold product line.
2. Johns Manville.
3. No substitutions.

C. Industrial Mineral Wool Products:
1. IIG Industrial Insulation Group LLC, a Calsilite/Johns Manville joint venture. MinWool

1200 product line.
2. Johns Manville.
3. No substitutions.

D. Removable, Reusable Insulation Covers:
1. Advance Thermal Corp.
2. Pacor, Inc.
3. Thermal Science Technologies.
4. Thermaxx LLC.
5. No substitutions.

E. Glass Fiber Insulation Sealing Tapes:
1. Venture Tape Corporation.
2. 3M Company.
3. Ideal Tape Co., division of American Biltrite Inc.
4. Nashua Tape Products, division of Berry Plastics Corp.
5. No substitutions.

F. Accessories:
1. Ceel-Co division of Johns Manville (product: plastic jacket systems).
2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B. Fuller (mastics, sealants, reinforcing membranes, and accessories).
3. Johns Manville (products: Super-Seal acrylic polymer coatings).
4. Vac Systems International (product: Tough Coat acrylic polymer mechanical insulation repair coating).

2.2 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553; flexible, noncombustible.
1. 'K' (KSI) Value: ASTM C177 or ASTM C518, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.
4. Density: 1.5 lb/cu. ft.

B. Vapor Barrier Jacket:
1. ASTM C1136, Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier film. Facing as required for the application. Integral staple flap on one edge.
a. Aluminum Faced: FSK (aluminum foil-scrim-kraft) construction.
b. White Faced: PSK (polypropylene-scrim-kraft) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150 degrees F.
4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.

C. Vapor Barrier Lap Adhesive: Compatible with insulation.

D. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

2.3 GLASS FIBER, RIGID

A. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
1. 'K' (KSI) Value: ASTM C177 or ASTM C518, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.1 percent by volume.
4. Density: 3.0 lb/cu. ft.

B. Vapor Barrier Jacket:
1. ASTM C1136, kraft paper reinforced with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
a. Aluminum Faced: FSK (foil-scrim-kraft) construction
b. White Faced: ASJ (all-service jacket) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150 degrees F.
4. Overlap longitudinal laps and butt strips.
5. Secure insulation with mechanical fasteners to substrate, and seal jacket with pressure sensitive tape.

C. Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.4 GLASS FIBER, SEMI-RIGID

A. Insulation: ASTM C612; semi-rigid, noncombustible blanket, with fibers oriented perpendicular to insulation surface to provide compressive strength while maintaining flexibility. Supplied in roll form, suitable for application on rounded shapes such as pipes, tanks, ducts, vessels, and other similar round and irregular shapes.
1. 'K' ('Ksi') value: ASTM C518, 0.24 at 75 degrees F.
2. Maximum service temperature: 450 degrees F.
3. Maximum moisture absorption: 1.0 percent by volume.
4. Density: 2.5 lb/cu. ft.

B. Vapor Barrier Jacket:
1. ASTM C1136, kraft paper with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
a. Aluminum Faced: FSK (foil-scrim-kraft) construction
b. White Faced: ASJ (all-service jacket) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150 degrees F.

4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.

C. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.

D. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.5 GLASS FIBER, PREFORMED PIPE COVERING

A. Insulation: ASTM C547; rigid molded, noncombustible.
1. 'K' ('Ksi') value: ASTM C177, 0.24 Btu-in/(hr-sq.ft- degrees F) at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket:
1. ASTM C1136, ASJ (all-service jacket) construction, white kraft paper with glass fiber yarn, bonded to aluminized film.
2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Vapor Barrier Tape: Provide self-adhesive butt strips furnished by the insulation manufacturer, with finish to match the insulation outer finish.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.

H. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

I. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

J. Insulating Cement: ASTM C449/C449M.

2.6 GLASS FIBER INSULATION SEALING TAPE

A. Self-adhesive tape with integral vapor barrier, pressure sensitive acrylic-based or rubber-based adhesive, and release liner strip. Width 3 inch nominal.

B. Manufactured by VentureTape, by the insulation manufacturer, or by one of the other tape

manufacturers listed in the article “Manufacturers” in this Section.

C. Types:
1. For rigid and semi-rigid insulations, tape shall be reinforced type. For flexible “duct wrap” insulation, tape shall be either reinforced or non-reinforced.
2. White or aluminum outer surface to match the insulation.
3. Reinforced: Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier layer.
   a. Aluminum Finish with FSK: VentureTape 1525CW.
   b. White Finish with ASJ: VentureTape 1540CW
   c. White Finish with PSK: VentureTape 1531CW.
4. Non-Reinforced: Foil insulation tape. Dead-soft temper 2 mil thick aluminum foil, without reinforcement. Hand-tearable.
   a. Venture Tape 3520CW.
5. Performance:
   a. Peel Adhesion: PSTC-101 with 20 minute dwell, 45 oz/in.
   b. Shear Adhesion: PSTC-107, 2.2 psi after 24 hours.
   c. Tensile Strength: PSTC-131:
      1) Reinforced Types: 40 lb/in.
      2) Non-reinforced Types: 21 lb/in.
   d. Elongation: PSTC 131, 6 percent maximum.
   e. Service Temperature: -40 to 240 degrees F.
   f. UL 723 listed or classified (flame/smoke rating).

2.7 HYDROUS CALCIUM SILICATE

A. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
1. 'K' (KSI) Value: ASTM C177, C518, and C335; 0.45 Btu-in/(hr-sq.ft- degrees F) at 300 degrees F.
2. Maximum Service Temperature: ASTM C447; 1200 degrees F.
3. Density: ASTM C302; at least 14 lb/cu ft.
4. Compressive Strength: ASTM C165; at least 100 psi at 5 percent compression.
5. Flexural Strength: ASTM C203; at least 50 psi.

B. Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12-inch centers.

C. Insulating Cement: ASTM C449. Apply with fibrous glass cloth reinforcement.

2.8 INDUSTRIAL MINERAL WOOL

A. Insulation: ASTM C547 Types I, II, and IV; rigid molded, asbestos free, basaltic rock fiber, off-white or darker color.
1. 'K' (KSI) Value: ASTM C335; 0.22 Btu-in/(hr-sq.ft- degrees F) at 75 degrees F.
2. Maximum Service Temperature: ASTM C447; 1200 degrees F.
3. Water Vapor Sorption: ASTM C1104 at 120 degrees F and 95 percent RH; <1 percent by weight, <0.02 percent by volume.
4. Recovery after 10 percent compression: 100 percent.
5. Density: 3.0 lb/cu ft.

B. Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12 inch centers.

C. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.9 REMOVABLE, REUSABLE INSULATION COVERS

A. Insulation:
1. Fiberglass or mineral wool mat insulation.
2. Insulation thickness shall be as required to limit exterior temperature to 120 degrees F.

B. Jacket:
1. PTFE-fiberglass composite jacketing, industrial grade, 13.5 oz/sq. yd minimum. Room-side surface in well-vented indoor locations, or cold-equipment-side surface of jacketing may be either PTFE-fiberglass or silicone-fiberglass.
2. Breather vents and drain orifices, brass or stainless steel.
3. Stitching: Double-sewn lock stitching with non-melting thread.
4. Insulation shall be sewn integral to jacket to prevent shifting.
5. Insulating mat shall be placed in overlapping pattern to minimize convection currents.
6. Jacket shall completely encapsulate insulation.
7. Cut jacket material edges shall be folded under and concealed.
8. Provide a permanently attached Aluminum or stainless steel nameplate on each jacket to identify its location, size and tag number.

C. Fastening:
1. Jackets shall be fastened using hook and loop (“Velcro” type) straps and 1-inch (25 mm) slide buckles. Hog rings, staples, wires, and other devices are not acceptable.
2. Jacket pieces which match mating seams shall include an extended 2-inch (50 mm) flap constructed from the exterior fabric and shall be secured using hook and loop closure parallel to the seam.

D. Box Shape: Covers for magnetic filters and associated piping assemblies shall be constructed in a box shape for ease of removal and replacement inspection.

E. Service Rating: Maximum equipment temperature 700 degrees F.

F. Warranty: 5-year materials and labor.

2.10 JACKETS

A. PVC Plastic:
1. Jacket: ASTM D1784, Sheet material, off-white color.
   a. Minimum Service Temperature: -40 degrees F.
   b. Maximum Service Temperature: 150 degrees F.
   c. Moisture Vapor Transmission: ASTM E96; 0.002 perm-inches.
   d. Thickness: 20 mil.
   e. Connections: Brush on welding adhesive.
2. Covering Adhesive Mastic: Compatible with insulation.

B. Canvas Jacket: UL listed.
   1. Fabric: 6 oz/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
   2. Lagging Adhesive: Compatible with insulation.

C. Fibrous Glass Fabric:
   1. Cloth: Heat treated to remove most organic binders. May be factory-impregnated with an inorganic fire-retardant rewettable adhesive, at Contractor's option.
   2. Weight: 9 oz/sq yd minimum.
   3. Blanket: 1.0 lb/cu ft density.
   4. Weave: 10x20 per inch.
   5. Service Temperature: 1000 degrees F.

2.11 SHIELDS, INSERTS, AND SADDLES:

A. Shields: Galvanized steel formed in at least a 90 degree arc. Minimum 18 gauge thickness. Minimum 12 inches long.

B. Inserts:
   1. Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   2. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

C. Saddles:
   1. Factory fabricated of curved carbon steel plate, of same overall thickness and contour as adjoining insulation. Sides designed for welding to pipe. Center support plate for pipe sizes 12 inches and larger.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Division 01 Section "Quality Requirements": Manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards where applicable.

C. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2016, applicable State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.

D. Factory Insulated Equipment: Do not insulate.

E. Exposed Equipment: Locate insulation and cover seams in least visible locations.

F. Where rigid glass fiber insulation is scheduled, semi-rigid glass fiber insulation may be used on round and flat oval and irregular shapes, and preformed pipe insulation may be used on small diameter round items.

G. Insulated equipment containing fluids below ambient temperature: Insulate entire system.

H. For hot water heating system equipment, insulate flanges and unions with removable sections and jackets.

I. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.

J. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

K. Shields, Inserts, and Saddles:
1. Application: Provide shields at hangers. Provide inserts for equipment 1-1/2 inches diameter or larger. Provide saddles for equipment 6 inches and larger.
2. Shield location: Between insulation jacket and hanger.
3. Insert location: Between support shield and equipment and under the finish jacket.
4. Saddle location: Between support shield and equipment.
5. Tack-weld saddles to the equipment. Fill air spaces within the saddle with insulation material.
6. Glue shields to outside of insulation after system is filled and run at operating temperature.
7. Align mid-length of shields, inserts, and saddles with the hanger centerline.

L. Finish insulation at supports, protrusions, and interruptions.

M. Equipment Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.

N. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

O. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

P. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

Q. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

R. Insulate equipment after system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust and scale, and dried. Ensure full range of motion of equipment

actuators. Modify insulation to avoid obstruction with valve handles, safety reliefs, and other components requiring movement. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:

1. Nameplate labels.
2. Valve hand wheels.
3. ASME stamps.

S. Equipment Insulation:

1. General Procedures: Apply equipment insulation suitable for temperature and service in rigid block or semi-rigid board or flexible form to fit as closely as possible to equipment. Groove or score insulation where necessary to fit the contours of equipment. Stagger end joints where possible. Bevel the edges of the insulation for cylindrical surfaces to provide tight joints. Bevel insulation around name plates, ASME Stamp, and access plates. For insulation on equipment that must be opened periodically for inspection, cleaning, or repair, construct insulation to be removable and replaceable without damage. Protect exposed insulation corners with corner angles under wires and bands.
2. Fill mineral fiber joints with insulating cement conforming to ASTM C195.

T. Heating Equipment (Except Pumps):

1. Seal joints with bedding compound for cellular glass or for mineral fiber with ASTM C195 insulating cement and cover insulation with a smoothing coat of insulating cement. Apply two coats of adhesive with a layer of glass cloth embedded between coats. The dry film thickness of the finish shall be 1/32-inch minimum.
2. Insulate shell and tube heat exchangers for the temperature of the shell medium indicated on the drawings. Insulation on heads of heat exchangers shall be removable. Fabricate a male-female shiplap type joint for the removable section.

U. Removable Reusable Equipment Covers:

1. Provide on equipment requiring periodic or frequent service, including but not limited to magnetic filters, and large valves and fittings as referenced in Division 23 Section "HVAC Piping Insulation."
2. Equipment Nameplates: It is acceptable to insulate over nameplates with this type cover.
3. Field-verify installed dimensions prior to ordering covers.

V. Insulate equipment and accessories as specified in Table IIn addition, comply with the other requirements of this Section.

3.3 PAINTING AND IDENTIFICATION

A. Paint in accordance with Division 09 Sections "Interior Painting" and "Exterior Painting."

3.4 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to Specifications. Inspect installations progressively for compliance with requirements.

TABLE I
EQUIPMENT INSULATION MATERIAL AND WALL THICKNESS

EQUIPMENT	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS
Magnetic Filters, and Hydronic Heat Exchangers	Removable, Reusable Insulation Covers	No	2 inches
Hot Water Irregular Shapes	Glass Fiber, Rigid	No	2 inches
Hot Water Duct Mounted Coils	Glass Fiber, Flexible	Yes	2 inches
Humidifier Drain Cooler	Glass Fiber, Rigid	No	1 inch

END OF SECTION 230716

SECTION 230719 – HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

C. Shields, Inserts, and Saddles.

1.2 RELATED SECTIONS

A. Division 07 Section “Through Penetration Firestop Systems.”

B. Division 09 Sections “Interior Painting” and “Exterior Painting”: Painting insulation jacket.

C. Division 23 Section “Identification for HVAC Piping and Equipment.”

D. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”: Placement of hangers and hanger inserts.

E. Division 23 Section “Steam Humidifiers.”

1.3 REFERENCES

A. Division 01 Section “References”: Requirements for references and standards.

B. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.

E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

F. ASTM C240 - Standard Test Methods of Testing Cellular Glass Insulation Block.

G. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

H. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

I. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

J. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

K. ASTM C547 - Standard Specification for Mineral Fiber Preformed Pipe Insulation.

L. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

M. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

N. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

O. ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

P. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).

Q. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

R. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

T. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

U. NAIMA National Insulation Standards.

V. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

W. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures”.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches.

B. Insulation materials and accessories shall be asbestos-free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.

B. Maintain ambient conditions required by manufacturers of each product.

C. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cellular Glass Products:
1. Pittsburgh Corning USA. Foamglas product line.
2. No substitutions.

B. Elastomeric Foam Products:
1. Armacell LLC.
2. K-Flex USA.
3.
4. No substitutions.

C. Glass and Mineral Fiber Products:
1. Knauf Insulation.
2. Certainteed Corporation.
3. Johns Manville.
4. Owens Corning.
5. No substitutions.

D. Hydrous Calcium Silicate Products:
1. IIG Industrial Insulation Group LLC, a Calsilite/Johns Manville joint venture. Thermo-

12 Gold product line.
2. Johns Manville.

E. Industrial Mineral Wool Products:
1. IIG Industrial Insulation Group LLC, a Calsilite/Johns Manville joint venture. MinWool 1200 product line.
2. Johns Manville.

F. Accessories:
1. Ceel-Co division of Johns Manville (product: plastic jacket systems).
2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B. Fuller (mastics, sealants, reinforcing membranes, and accessories).
3. Johns Manville (products: Super-Seal acrylic polymer coatings, Zeston plastic jacket systems).
4. Pabco/Childers Metals, division of ITW Insulation Systems (products: metal jacket systems, and accessories).
5. Proto Corporation (product: plastic jacket systems).
6. Vac Systems International (product: Tough Coat acrylic polymer mechanical insulation repair coating).

2.2 ELASTOMERIC FOAM

A. Products:
1. Armacell: AP Armaflex and AP Armaflex FS pipe and sheet insulation.
2. K-Flex USA: Insul-Tube and K-Flex LS pipe insulation, and Insul-Sheet S2S and K-Flex LS sheet insulation.
3. No substitutions.

B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
1. 'K' ('Ksi') value: ASTM C177; 0.277 Btu-in/(hr-sq.ft- degrees F) at 75 degrees F.
2. Minimum service temperature: -70 degrees F (flexible to -20 degrees F).
3. Maximum service temperature:
a. Standard Insulation (NBR/PVC material): 220 degrees F.
b. High Temperature Insulation (EPDM material: 300 degrees F.
4. Maximum moisture absorption: ASTM C209, 0.2 percent by volume; or ASTM D1056, 5 percent by weight.
5. Moisture vapor transmission: ASTM E96; 0.1 perm-inches.
6. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Insulated Hanger Inserts: At Contractor’s option, Eaton B-Line Armafix insulated pipe hanger inserts may be used at hanger locations.
1. Engineered from Armaflex insulation, with inserts of CFC-free PPUR/PIR polyurethane foam insulation bearing segments.
2. Outer shell of 30 mils-thick painted aluminum.
3. Self-adhesive closure strip.
4. Provide Armaflex insulation tape, wrapped around the IPH prior to placing in the hanger.

2.3 GLASS FIBER

A. Insulation: ASTM C547; rigid molded, noncombustible.
1. 'K' ('Ksi') value: ASTM C177, 0.24 Btu-in/(hr-sq.ft- degrees F) at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket:
1. ASTM C1136, White kraft paper with glass fiber yarn, bonded to aluminized film.
2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

F. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.

G. Insulating Cement: ASTM C449.

2.4 HYDROUS CALCIUM SILICATE

A. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
1. 'K' (KSI) Value: ASTM C177, C518, and C335; 0.45 Btu-in/(hr-sq.ft- degrees F) at 300 degrees F.
2. Maximum Service Temperature: ASTM C447; 1200 degrees F.
3. Density: ASTM C302; at least 14 lb/cu ft.
4. Compressive Strength: ASTM C165; at least 100 psi at 5 percent compression.
5. Flexural Strength: ASTM C203; at least 50 psi.

B. Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12 inch centers.

C. Insulating Cement: ASTM C449. Apply with fibrous glass cloth reinforcement.

2.5 INDUSTRIAL MINERAL WOOL

A. Insulation: ASTM C547 Types I, II, and IV; rigid molded, asbestos free, basaltic rock fiber, off-white or darker color.
1. 'K' (KSI) Value: ASTM C335; 0.22 Btu-in/(hr-sq.ft- degrees F) at 75 degrees F.
2. Maximum Service Temperature: ASTM C447; 1200 degrees F.
3. Water Vapor Sorption: ASTM C1104 at 120 degrees F and 95 percent RH; <1 percent by weight, <0.02 percent by volume.
4. Recovery after 10 percent compression: 100 percent.
5. Density: 3.0 lb/cu ft.

B. Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12 inch centers.

C. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.6 JACKETS

A. PVC Plastic.
1. Jacket: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
a. Minimum service temperature: 0 degrees F.
b. Maximum service temperature: 150 degrees F.
c. Moisture vapor transmission: ASTM E96; 0.002 perm-inches.
d. Thickness: 30 mil.
e. Connections: Brush on welding adhesive, tacks (for heating systems only) or pressure sensitive color matching vinyl tape.
2. Covering Adhesive Mastic: Compatible with insulation.

B. Canvas Jacket: UL listed.
1. Fabric: 6 oz/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
2. Lagging Adhesive: Compatible with insulation.

C. Fibrous Glass Fabric:
1. Cloth: Heat treated to remove most organic binders. May be factory-impregnated with an inorganic fire-retardant rewettable adhesive, at Contractor's option.
2. Weight: 9 oz/sq yd minimum.
3. Blanket: 1.0 lb/cu ft density.
4. Weave: 10x20 per inch.
5. Service Temperature: 1000 degrees F.

D. Aluminum Jacket: ASTM B209, ASTM B209M.
1. Thickness: 0.016 inch sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

E. Stainless Steel Jacket: ASTM A167 Type 304 stainless steel.
1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

2.7 SHIELDS, INSERTS, AND SADDLES

A. Shields:
1. Carpenter and Paterson Figure 265GS, or equal.
2. Galvanized or electro-galvanized steel, minimum 12 inch length, minimum 120-degree arc, minimum 18 ga.
3. Provide contact adhesive to glue shields to the insulation.

B. Snap-On Shields:
1. Eaton B-Line "Snap-N Shield".

2. Snap-N Shield is an acceptable substitute for metal shields when installed with strut trapeze hangers on horizontal piping.
3. Paintable polypropylene plastic 12 inch long preformed shields, snap-on design for attachment to strut.
4. Gluing is not required with Snap-N Shield.
5. Provide black or white color to match the insulation in areas exposed to public view.

C. Inserts:
1. Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
2. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

D. Saddles:
1. Factory fabricated of curved carbon steel plate, of same overall thickness and contour as adjoining insulation. Sides designed for welding to pipe. Center support plate for pipe sizes 12 inches and larger.

2.8 MANUFACTURER'S STAMP OR LABEL

A. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use shall have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation packages and containers shall be asbestos-free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Division 01 Section "Quality Requirements": Manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards where applicable.

C. Provide insulation for surfaces of piping as indicated and specified.

D. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2016, applicable State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.
1. International Energy Conservation Code (IECC): Chapter 5 of the Code allows the use of ASHRAE 90.1 insulation thicknesses instead of the Minimum Pipe Insulation table which is in Chapter 5 of the IECC. This Specification does not reference the table in IECC.

E. Piping systems requiring insulation, types of insulation required, and insulation thickness shall be as listed in Table I herein. For piping not listed in Table 1, insulate to meet Code requirements, using suitable specified materials, subject to Architect's approval. Except for flexible unicellular insulation, insulation thicknesses as specified in Table I shall be one inch greater for insulated piping systems located outside the building and in unconditioned spaces. Unless otherwise specified, insulate fittings, flanges, and valves, except valve stems, hand wheels, and operators. Use factory pre-molded, precut, or field-fabricated insulation of the same thickness and conductivity as used on adjacent piping. Insulation exterior shall be factory cleanable, grease resistant, non-flaking, and non-peeling.

F. Exposed Piping: Locate insulation and cover seams in least visible locations.

G. Insulated Pipes Conveying Fluids Below Ambient Temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

H. Glass Fiber Insulated Pipes Conveying Fluids below Ambient Temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

I. For hot water heating systems, insulate flanges and unions at equipment.

J. Glass Fiber Insulated Pipes Conveying Fluids above Ambient Temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

K. For piping which may operate at a range of temperatures (for example, heat recovery and heat exchange piping), provide insulation and vapor barriers as are suitable for the entire range of operation.

L. Large Valve Bodies and Other Fittings: Large valves and other fittings requiring service access may be insulated with removable, reusable equipment covers with "Velcro" closures. Refer to Division 23 Section "HVAC Equipment Insulation."

M. Branches to Expansion Tanks: For hot water systems, insulate from the connection at the main to at least 10 feet toward the tank.

N. Branches to Gauges, Sensors, Drains, and Vents: Insulate branches to gauges, sensors, drains, and vents as for active sections of piping. For piping with operating temperatures above ambient, insulate to at least 6 inches from the active main. For temperature devices, insulate to include the sensing bulb or other element. For pressure devices in hot piping with syphon loops, insulate from the active main to the syphon loop, but it is not necessary to insulate the syphon loop or the portion of the branch on the device side of the syphon loop.

O. Shields, Inserts, and Saddles:
1. Application: Provide shields at hangers. Provide inserts for piping 2 in. nominal size or larger. Provide saddles for piping 6 in. nominal size and larger and for generator exhaust piping and muffler.
2. Shield location: Between insulation jacket and hanger.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Saddle location: Between support shield and piping.
5. Tack-weld saddles to the pipe or muffler. Fill air spaces within the saddle with insulation material.
6. Glue shields to outside of insulation after system is filled and run at operating temperature.
7. Align mid-length of shields, inserts, and saddles with the hanger centerline.

P. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Division 07.

Q. Pipe Exposed in basements and Mechanical Equipment Rooms 7 feet or Less Above Finished Floor:
1. Piping Which Crosses Walking and Service Access Paths 4 feet or Less Above Finished Floor: Finish with aluminum or stainless steel jacket and fitting covers.
2. Other Piping: Finish with PVC or ABS jacket and fitting covers.

R. Pipe Exposed in Finished Spaces 10 feet or Less Above Finished Floor: Finish with PVC or ABS jacket and fitting covers.

S. Exterior Applications:
1. Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass-mesh-reinforced vapor barrier cement.
2. Hot Water Piping: Cover with aluminu] jacket and fitting covers with seams located on bottom side of horizontal piping.
3. Other Piping: Cover with PVC jacket and fitting covers with seams located on bottom side of horizontal piping.

3.3 UNIFORM INSTALLATION

A. Systems shall use a single insulation type throughout the installation.

3.4 PREPARATION

A. Insulate piping after system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction of valve handles, safety reliefs, and other components requiring movement. Allow adequate space for pipe expansion. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer’s recommended coverage per gallon. Individually insulate piping. Provide a moisture and vapor seal where insulation terminates against metal

hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:

1. Piping in radiation enclosures, or within cabinets of unit heaters.
2. Valve hand wheels.
3. Vibration isolating connections.
4. Adjacent insulation.
5. ASME stamps.

3.5 PIPING INSULATION

A. Pipe Insulation (Except Elastomeric Insulation): Place sections of insulation around the pipe and joints tightly butted into place. The jacket laps shall be drawn tight and smooth. Secure jacket with fire resistant adhesive, factory applied self sealing lap. Cover circumferential joints with butt strips, not less than 3-inches wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches. Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps. When a vapor barrier jacket is required, as indicated in Table I, or on the ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, use a vapor-barrier coating conforming to manufacturer's weatherproof coating for outside service. Apply this vapor barrier coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, and coating as specified for butt strips. Extend the patch not less than l-l/2 inches past the break in both directions. At penetrations by pressure gauges and thermometers, fill the voids with the vapor barrier coating for outside service. Seal with a brush coat of the same coating. Where penetrating roofs, insulate piping to a point flush with the top of the flashing and seal with the vapor barrier coating. Butt tightly the exterior insulation to the top of the flashing and interior insulation. Extend the exterior metal jacket 2 inches down beyond the end of the insulation. Seal the flashing and counterflashing underneath with the vapor barrier coating.

B. Elastomeric Foam Insulation: Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral-fiber insulation inserts and sheetmetal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer’s published instructions. Apply two coats of vinyl lacquer finish to elastomeric foam insulation before applying PVC jacket in outside locations.

C. Seal surfaces of fibrous insulation to prevent release of fibers.

D. Sleeves and Wall Chases: Where penetrating interior walls, extend a metal jacket 2 inches on either side of the wall and secure on each end with a band. Where penetrating floors, extend a metal jacket from a point below the back-up material to a point 10 inches the floor with one band at the floor and one not more than one inch from end of metal jacket. Where penetrating exterior walls, extend the metal jackets through the sleeve to a point 2 inches beyond the interior surface of the wall.

3.6 PAINTING AND IDENTIFICATION

A. Paint in accordance with Division 09 Sections “Initerior Painting” and “Exterior Painting”.

Piping identification shall be as specified in other sections.

3.7 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to specifications. Inspect installations progressively for compliance with requirements.

TABLE I
PIPING INSULATION MATERIAL AND WALL THICKNESS

SERVICE	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS AT THE FOLLOWING PIPE DIAMETERS				
			<1 inch	1 inch to <1.5 inches	1.5 inches to <4 inches	4 inches to <8 inches	8 inches or Greater
Heating Systems (Hot Water Supply and Return)	Glass Fiber	No	1.5 inches	1.5 inches	2 inches	2 inches	N/A
Humidifier Steam discharge, and Humidifier Drain to Drain Cooler	High Temperature Elastomeric Foam	N/A	1 inch	1 inch	1 inch	N/A	N/A
	Glass Fiber	No	1 inch	1 inch	1 inch	N/A	N/A
Air Conditioning Condensate Drain Located Inside Building	Elastomeric Foam	N/A	0.75 inches	0.75 inches	1 inch	1.5 inches	1.5 inches
	Glass Fiber	Yes	0.75 inches	0.75 inches	1 inch	1.5 inches	1.5 inches
Refrigerant Suction and Gas Piping	Elastomeric Foam	N/A	1 inch	1 inch	1 inch	1.5 inches	N/A
Refrigerant Liquid Piping	Elastomeric Foam	N/A	0.5 inch	0.5 inch	1 inch	1 inch	N/A

END OF SECTION 230719

SECTION 230900 – INSTRUMENTATION AND CONTROL FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Direct Digital Control (DDC) equipment.

B. Software.

C. Installation.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Piping:

1. Control Valves – piping connections.
2. Temperature Sensor Wells and Sockets.
3. Pressure Sensors and Switches.
4. Flow Switches.
5. Flow Meters.

B. Ductwork:

1. Access Doors.
2. Airflow Measuring Stations.
3. Dampers - ductwork connections.

1.3 PRODUCTS FURNISHED UNDER OTHER SECTIONS

A. Controllers furnished with some Plumbing equipment (Division 22).

B. Controllers furnished with some HVAC equipment (Division 23).

1.4 RELATED SECTIONS

A. Division 23 Section “Common Work Results for HVAC.”

B. Division 23 Section “Common Motor Requirements for HVAC Equipment.”

C. Division 23 Section "Identification for HVAC Piping and Equipment."

D. Division 23 Section “Testing, Adjusting, and Balancing for Mechanical Systems.”

E. Division 26 – Electrical wiring and raceway requirements.

1.5 REFERENCES

A. U.S. Department of Justice – 2010 ADA Standards for Accessible Design.

B. ASME MC85.1 - Terminology for Automatic Control.

C. NEMA EMC1 - Energy Management Systems Definitions.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NFPA 70 - National Electrical Code.

F. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

G. State of Maine Bureau of General Services Property Management Division – Heating Ventilation and Air Conditioning (HVAC) Building Control Center (BCC) Integration Scope, October 2024 or newer edition.

1.6 GENERAL DESCRIPTION

A. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface. DDC system is for monitoring and controlling various HVAC and Plumbing systems. The control system shall be seamlessly integrated with the State of Maine Building Control Center (BCC) which provides 24 hours a day, 7 days a week, 365 days a year monitoring of state facilities. The HVAC controls shall be an extension of the existing Honeywell Enterprise Building Integrator (EBI) with host server hardware located in Augusta Maine. The Building Automation System (BAS) shall enable monitoring and control of mechanical systems installed under the scope of this project through to the BCC. Integration of HVAC system, panels, associated devices, front-end programming, and graphics is proprietary to Honeywell International Inc. Contact: Bob Masland, Senior Account Executive, Honeywell Building Technologies; Robert.Masland2@Honeywell.com.

B. DDC system shall interface with an existing BCC building control center enterprise system to adhere to Owner standards already in-place and to achieve integration. Integration is limited to 3 State of Maine network connections.

C. Engage Owner's control system integrator Honeywell EBI to provide the following services:

1. Enterprise system expansion and development of graphics, logs, reports, trends, and other operational capabilities of enterprise system for I/O being added to DDC control system for use by enterprise system operators.
2. Assistance during commissioning to extent of DDC system integration with existing enterprise system.
3. Prepare on-site demonstration mockup of integration of DDC system to be installed with existing system before installing DDC system.

D. Graphic Interface:

1. The graphics interface shall be designed and installed by Honeywell EBI for the BCC system.
2. Graphic Interface shall have a similar look, feel, and operation as other controls in existing State of Maine Buildings.
3. Modifications to the DDC system graphics is done through the system integrator – Honeywell EBI.

4. The graphics interface shall be designed and installed by Honeywell EBI for the BCC system.
   Graphic Interface for the Daschlager House shall have a similar look, feel, and operation as other controls in existing State of Maine Buildings.
5. Modifications to the DDC system graphics is done through the system integrator – Honeywell EBI.

E. Reports and logs shall be provided via the existing Honeywell EBI system and shall include the following:

1. I/O: With current status and values.
2. Alarm: Current alarms, except those in alarm lockout.
3. Disabled I/O: I/O points that are disabled.
4. Alarm Lockout I/O: I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: I/O in alarm lockout that are currently in alarm.
6. Logs:
   a. Alarm history.
   b. System messages.
   c. System events.
   d. Trends.
   e. Communications.

F. One of the following communication types which are supported by the Honeywell Building Manager (EBI) shall be used. Note controls package will be limited to 5 HVAC network IP addressable devices, any request to add additional network devices would need approval.

1. Modbus
2. LON Works
3. BACnet
4. XL Direct
5. XL Net
6. BNPS
7. C-Bus
8. OPC

G. The scope shall include, but not be limited to, integration of the following items, if part of the installation:

1. Air temperature sensors / switches.
2. Blower Coil units.
3. Condensing Units serving blower coil units.
4. Control Modes.
5. Control valves and actuators.
6. Convection heating and cooling units.
7. Cubic Feet per Minute (CFM) sensor.
8. Damper Position.
9. Dehumidification units.
10. Energy Recovery Ventilators.
11. Fan Status.
12. Freeze Stat.

13. Glycol makeup units.
14. Heat Exchangers.
15. Heat Pumps system.
16. Humidity sensors.
17. Loop Temperatures.
18. Occupied / Unoccupied Status.
19. Outside Air Temperature
20. Pump Status.
21. Pump run times.
22. Reheats.
23. Sewage ejector pumps.
24. Split system air conditioners and heat pumps.
25. Sump pumps.
26. Temperature and moisture instruments.
27. System Control Mode.
28. Supply and return temperatures.
29. Unit Status.

H. The State of Maine has a requirement for no local space temperature sensor control by occupants. Space sensor control shall follow State standard of 68 degrees for heating and 75 degrees for cooling.

I. System Capabilities:

1. Alarming - Not necessarily limited to the following:
   a. Damper Status
   b. Fan Failure
   c. Filter Status
   d. Flame Failure
   e. High & Low Temperatures
   f. High CO
   g. Sensor High & Low values
   h. Unit Status

2. Trending:
   a. Dampers
   b. Overrides
   c. Sensors
   d. Temperatures
   e. Valves
   f. Unit status

3. Scheduling:
   a. Holidays
   b. Night setbacks

4. Operation:
   a. Start / stop capability

J. Graphics package shall be 5 star or better, and shall include detailed graphics customized for

the building including:

1. Controlled equipment and devices
2. Sensor locations
3. Building floor plans indicating:
   a. HVAC zones
   b. Current temperature and humidity conditions, as applicable.

K. When programming, the following point name structure shall be followed:

1. Short Descriptor Building Code, Device type – Device – parameter
2. Example – BRH_HEX_3_1/3_VlvCtrl
3. Long Descriptor City, Street Address, Device Location, Device type – Device – parameter
4. Augusta, 90 Blossom Lane, Basement, Heat Exchanger 1/3 Valve, Open

L. The State of Maine uses FORGE, an intuitive program that uses analytics to report abnormalities within the HVAC systems. New construction, retrofits, and upgrades require asset integration into FORGE.

M. The State of Maine uses Command & Control, an intelligent solution that provides more effective monitoring and optimization, and automates essential functions, for Card Management System, Digital Video Management, Energy management, HVAC, Life Safety, and Security. New construction, retrofits, and upgraded assets require modifications to the current facility Command and Control Suite model.

N. Licensing: New construction, retrofits, and upgrades require additional Honeywell EBI HVAC licensing points.

O. Point to Point Documentation & Verification: Is required for HVAC and plumbing equipment, location, valve operations, sensor readings, night setbacks, damper controls, and other controls.

1.7 DEFINITIONS

A. Definitions:

1. ATC: Automatic temperature control.
2. ATC Subcontractor: The Subcontractor primarily responsible for work of this Section.
3. DDC: Direct digital control.
4. I/O: Input/output.
5. PC: Personal computer.
6. PID: Proportional plus integral plus derivative.
7. RTD: Resistance temperature detector.

1.8 SUBMITTALS

A. Submit in accordance with Division 01 Section “Submittal Procedures.”

B. Qualification Data: For Installer and manufacturer.

C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. 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.

D. Shop Drawings: Detail equipment assemblies and indicate dimensions, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including size and flow characteristics.
8. DDC System Hardware:
    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control units.
9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:
    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.

E. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a solid state media or CD, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

F. Field quality-control test reports.

G. Operation and Maintenance Data.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. For mechanical instrumentation and control system to include in emergency, operation, and maintenance manuals.

C. In addition to items specified in Division 01, include the following:

1. Maintenance instructions and lists of spare parts for each type of control device.
2. Exploded assembly views.
3. Interconnection wiring diagrams with identified and numbered system components and devices.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

D. Manuals: Provide the following:

1. An Operator's Manual with graphic explanations of keyboard use for operator functions specified under Operator Training.
2. Computerized printouts of equipment controller’s data file construction including point processing assignments, physical terminal relationships, scales and offsets, command and alarm limits, and others as applicable.
3. A manual including revised as-built documents of materials required under the paragraph "SUBMITTALS" in this Specification Section.
4. Provide the quantity of manuals specified in Division 01, and at least 2 Operator’s Manuals and 2 As-Built Manuals to the Owner. Refer to other Sections of the Specifications for project requirements for quantities of documentation.

1.10 CODES AND APPROVALS

A. The complete temperature control installation shall be in accordance to the national and local electrical codes and the electrical Division of these Specifications. Devices designed for or used in line voltage applications shall be UL listed. Microprocessor based remote and central devices shall be UL916 Listed.

B. Electronic equipment shall conform to the requirements of FCC regulation Part 15, Section 15 governing radio frequency electromagnetic interference and be so labeled.

1.11 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section "Project Requirements."

B. Components to be Installed under Other Sections: For components to be installed under other Sections of the Specifications, provide delivery of components to appropriate Subcontractors, provide installation instructions, and supervise their installation.

1.13 COORDINATION

A. Coordinate location of thermostats and other exposed control sensors with Contract Drawings before installation.

B. Coordinate equipment with Division 26 and existing fire alarm system to achieve compatibility with equipment that interfaces with that system.

C. Coordinate line-voltage power supplies with Division 26.

1.14 WARRANTY

A. Components, system software, parts, and assemblies furnished under this Section shall be guaranteed against defects in materials and workmanship for 1 year from acceptance date.

B. Labor to troubleshoot, repair, reprogram, or replace system components shall be provided at no charge to the Owner during the warranty period.

C. Corrective software modifications made during warranty service periods shall be updated on user documentation and on user and manufacturer archived software disks.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SUPPLIERS

A. Acceptable Installer: See Article GENERAL DESCRIPTION in Part 1 of this Section.

B. The Temperature Control Contractor (or Subcontractor) shall hereinafter be referred to as the ATC Contractor.

2.2 SYSTEM REQUIREMENT

A. Provide complete control system consisting of temperature sensors, thermostats, control valves, dampers, operators, indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified. Provide controls for the systems listed in the Article GENERAL DESCRIPTION in Part 1 of this Section, and those indicated on the Drawings and in other Division 22 and 23 Sections of the Specifications.

B. Include interfaces to the building Fire Alarm system.

2.3 DATA INPUTS AND OUTPUTS

A. Input/output sensors and devices shall be closely matched to the requirements of the remote panel for accurate, responsive, noise-free signal input/output. Control input response shall be high-sensitivity and matched to the loop gain requirements for precise and responsive control.

B. Duct temperature sensors shall be rigid stem or averaging type as required. Provide water sensors with a separable copper, monel or stainless-steel well.

C. Control relays and analog output transducers shall be compatible with equipment controllers' output signals. Relays shall be suitable for the loads encountered.

2.4 TEMPERATURE CONTROL CENTRAL HARDWARE

A. Operator Workstations: The central operator workstation shall be located where directed by the Owner. Operator workstation shall be the standard form factor and features required by the State. Panel electronics shall be installed in suitable enclosures. Equipment room panels shall have hinged doors and shall also contain the load relays, transducers, and associated equipment.

B. Equipment controllers shall be 16 bit microprocessor based with EPROM operating system (O.S.). ATC programs and data files shall be non-volatile EEPROM or flash memory to allow simple additions and changes. Each equipment controller shall have an on-board real-time clock with battery backup of a minimum of 30 days.

1. DDC equipment controllers shall be provided with capacity to accommodate input/output (I/O) points required for the application plus spare points specified. These panels shall be configured with analog and digital inputs and outputs, and pulse counting totalizers and such that the primary input, the output and control logic shall be resident in a single microprocessor to provide network independent stand-alone closed loop ATC.

C. Terminal Equipment Controllers shall be EEPROM based and modularity expandable to accommodate additional points if required for future functional changes or enhancements, and with I/O selected for the application plus specified spares. Terminal controllers shall be capable of processing sensor signals of the applications specified, and shall have capability to drive digital (on-off), pulse width modulation, and true analog (0-10V) outputs. Terminal Controller enclosures shall be compact, finished steel to fit within or on terminal equipment. Each terminal controller shall have complete standalone capability.

2.5 DATA COMMUNICATIONS

A. Equipment controllers shall be interconnected via a primary communications network. Terminal controllers shall also be connected together via secondary networks to provide data concentration and parallel processing. Networks shall support sensor sharing, global application programs, and bus-to-bus communications without the presence of a host PC.

B. The equipment controller's communications network shall support true peer protocol such that loss of any single device will not cause total bus failure.

2.6 GENERAL

A. ATC setpoints, reset schedules, time programs, historical trends shall be displayable at local ATC panels and on the system’s operator workstations.

B. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with 3-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
6. Tri-State Outputs: Provide two coordinated binary outputs for control of 3-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

C. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-microsecond response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

D. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.7 SPARE POINTS

A. Provide a minimum of 10 percent spare points or 16 spare points, whichever is greater, in each ATC control panel for future use. Spare points shall be equally distributed among analog input, analog output, digital input and digital output. It is not intended that spare points be provided in unitary control panels which serve cabinet unit heaters, kickspace and wall heaters, baseboard radiation, fintube radiation, sump pumps, or sewage pumps. It is intended that spare points be provided in master control panels and in panels which serve boiler/mechanical rooms and major equipment such as boilers, pumps, blower coil units, and dehumidifiers.

2.8 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 26, provided under this Section.

2.9 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or 2-position action.

1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:
   a. Belimo.
   b. Honeywell.

2. Valves: Size for torque required for valve close-off at maximum pump differential pressure, and valve breakaway torque.
3. Dampers: Size for running torque as recommended by the damper manufacturer for tight sealing under design operating static pressures and velocities. Submit damper manufacturer’s torque chart in same submittal as actuator selection table.
   a. For dampers which do not list torque values, provide torque calculated as follows:
      1) Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
      2) Damper without Edge Seals: 5 inch-lb/sq. ftof damper.

4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (2-Position Spring Return): 24-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback

signal.

10. Temperature Rating: 40 to 104°F.
    a. In addition, valve actuators shall be suitable for the anticipated ambient temperature and fluid temperature. For example, actuators located within heating equipment terminal enclosures will experience higher temperatures.

11. Run Time: 30 seconds.
12. Actuator Housing: Molded or die-cast zinc or aluminum. Terminal unit actuators may be high-impact plastic with ambient temperature rating of 50 to 140 degrees F unless located in return-air plenums.
13. Damper actuators shall be provided with end switches.

2.10 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

1. Globe-type valves are required except for those applications where terminal-unit control valves or butterfly valves are specified or detailed.
2. Ball-type valves may be substituted for other types, and shall be characterized flow type.
3. Valves shall be suitable for water with up to 50 percent inhibited ethylene or propylene glycol.
4. 3-way valves shall be mixing pattern, except where diverting pattern is specified, or where manufacturer requires use of diverting pattern.
5. Rubber-paddle or ball-plug type control valves such as, but not limited to, Honeywell Fan-Coil Valves or the TAC Erie product line (division of Schneider Electric) are not allowed.
6. Valves with thermal-wax motors are not allowed.
7. Valves requiring cartridge replacement for service are not allowed.
8. Valves requiring special water treatment such as 50-micron filtration are not allowed.

B. Sizing: Maximum pressure drop determined with valve full-open at design flow rate and the following:

1. 2 Position: Line size.
2. 2-Way Modulating: Between one-half and one times the variable-flow load pressure drop, but not to exceed 3 psig.
3. 3-Way Modulating: Between one-half and one times the variable-flow load pressure drop, but not to exceed 1.5 psig.
4. Note: For modulating valves, the load pressure drop is that across the modulated portion of the system. For example, for a 3-way valve providing reset-water control at a boiler, the modulated flow is across the boiler and accessories, whereas the building loop to terminal equipment is considered constant-flow for the purposes of this valve's sizing. For a 3-way valve modulating the flow thru a coil, the coil and its pipe fittings comprise the variable-flow load. For a 3-way valve in a primary-secondary loop to a coil, where the flow thru the coil is a constant pumped flow, the variable load is in the primary-secondary bridge.

C. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 125 bronze (or red brass) body, bronze or brass seat, bronze trim, rising stainless steel stem, renewable brass or composition disc or plug, screwed ends, with backseating capacity, repackable under pressure. Valve may have integral union ends. Valves with ends other than threaded or factory-integral unions are not allowed.
2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
   a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
   b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. Flow Characteristics: 2-way valves shall have equal percentage characteristics; 3-way valves shall have linear characteristics through 1 of the ports, equal percentage through the other.
5. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for 2-way valves, and 100 percent of pressure differential across valve or 100 percent of total system (pump) head for 3-way valves.
6. Temperature Rating: 250°F.

D. Terminal Unit Control Valves: Bronze body, bronze trim, 2 or 3 ports as indicated, replaceable plugs and seats, and union and threaded ends. Valves with ends other than threaded or factory-integral unions are not allowed.

1. Applications: Kickspace heaters, wall heaters, cabinet unit heaters, baseboard radiation, and fintube radiation. For other applications, see globe valve specifications above.
2. Honeywell "small linear control valves" with "linear valve actuators" (or equal) may be used only for hot water duct coils; they may not be used for other coil or equipment types.
3. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
4. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating sufficient to close against pump shutoff head.
5. Flow Characteristics: 2-way valves shall have equal percentage characteristics; 3-way valves shall have linear characteristics.

2.11 DAMPERS

A. Manufacturers:

1. Insulated-Blade Dampers:
   a. T.A. Morrison & Co., Inc.; Tamco Series 9000 SC “Severe Cold Option” dampers.
   b. Greenheck – Series ICD-45.
   c. Ventex, Inc. - Series 3965SI.

B. Insulated Dampers: Dampers which are located in outdoor-air intakes and exhaust ducts shall be thermally insulated type.

1. Frame: Extruded aluminum, externally insulated with polystyrene foam.
2. Blades: Double wall extruded aluminum, with internal injected polyurethane foam, thermally broken. Extruded silicone frame and blade seals, secured in slots in the aluminum extrusions. R-value of complete blade shall be 2.29 hr-ft2-F/Btu.
3. Leakage shall not exceed 4.9 cfm/sq. ft against 4 in. wg differential static pressure at -40 degrees F.
4. Bearings: Celcon inner bearing fixed to a 7/16 inch aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
5. Linkage Hardware: Installed in the frame side, constructed of aluminum and corrosion-resistant, zinc-plated steel, with cup-point trunnion screws for a slip-proof grip.
6. Operating Temperatures: -40 to 155 degrees F
7. For dampers less than 12 inches in 1 dimension, provide “flanged-to-duct” mounting style for maximum free area.

C. Automatic dampers at exterior wall penetrations shall be shorter in vertical dimension (height) than the louver or duct penetration they serve, and mounted as high as possible to allow sloping of bottom of duct to drain outward. Coordinate sizing and positioning of dampers and louvers with Division 23 Section “Air Inlets and Outlets” to ensure proper installation to drain.

2.12 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Accuracy: Plus or minus 0.5°F at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
4. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
6. Room Sensor Cover Construction: See below.
7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. Humidity Sensors: Bulk polymer sensing element.

1. Accuracy: 2 percent full range with linear output.
2. Room Sensor Range: 20 to 80 percent relative humidity.
3. Room Sensor Cover Construction: See below.

D. Pressure Transmitters/Transducers:

1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
   a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
   b. Output: 4 to 20 mA.
   c. Duct Static-Pressure Range: 0- to 5-inch wg.

2. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
3. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

E. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Concealed.
2. Set-Point Indication: Concealed.
3. Thermometer: Concealed.
4. Communications Port: Standard phone-type jack for connection of portable laptop computer and other devices. Provide at each room sensor, no exceptions.
5. Override Pushbutton: For timed override of occupied/unoccupied cycle. Provide in normally-occupied rooms such as offices, conference room, special collections storage room, and Lobby. Do not provide in other storage rooms, stairs, entries, vestibules, corridors, and mechanical rooms.

F. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Adjusting Key: As required for calibration and cover screws. Furnish to the Owner, at least 5 per sensor type.
3. Wall Mounting Box: Recessed, steel, securely fastened to wall framing. Equal to Steel City metallic switch boxes by Thomas & Betts Corp. Box may only be omitted where sensor attaches directly to masonry construction.

2.13 THERMOSTATS AND TEMPERATURE SENSORS

A. Thermostats and Sensors in locations in regular view by the occupants shall have covers which are simple, aesthetically pleasing, neutral in color, with manufacturer’s logo, if any, in black or neutral color, and shall fit flush to the surrounding wall surface.

B. Freezestats:

1. Freezestat safety low limits shall be duct-mounted manual-reset and automatic-reset (see control sequences) 20-foot limited fill capillary-tube type, responsive to the coolest section of its length.
2. Air handling systems which handle outside air (or a mix of outside air and return air) or are located outdoors shall have freezestats at hydronic coils. Where freezestats are required, provide manual-reset type set near freezing temperature for shutdown, and an automatic-reset type set at a warmer temperature for preventive action.

C. Thermostats:

1. Electric thermostats shall be line voltage or low voltage type, suitable for the application. They shall have exposed setpoint adjustment and setpoint indicator.
2. Wall heater aquastats shall be strap-on type.

D. Room Temperature Sensors:

1. Temperature sensors shall provide a 2-wire connection to the controller that is polarity and wire type insensitive. Sensors shall have communications jacks for connection to the communication trunk to which the controller is connected. The temperature sensor, the connected controller, and other devices on the communications bus shall be accessible by the Graphical Programming tool.
2. Provide with override buttons where specified which, when depressed during unoccupied time periods, will override the zone's temperature controls and setpoints to occupied conditions for a user adjustable period of time (initially set for 2 hours).

2.14 STATUS SENSORS

A. Where differential pressure "sensor" is indicated or specified, they shall be analog-output type as specified herein. Where differential pressure "switch" is indicated, it may be digital-output type.

B. Status Inputs for Fans: Unless otherwise specified: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).

C. Status Inputs for Pumps: Unless otherwise specified: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.

D. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

E. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

F. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4-20 mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

G. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

H. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

I. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.15 CURRENT TRANSFORMERS

A. Current transformers (CTs) are not an acceptable substitute for pump or fan monitoring where flow switches or pressure switches are specified.Provide CTs as required for the sequences of operation specified.

2.16 DIFFERENTIAL WATER PRESSURE SENSORS

A. Manufacturers:

1. Setra - Model 230 Wet-to-Wet Pressure Transducer.
2. Ashcroft.
3. Honeywell.
4. Johnson Controls.

B. At Contractor's option, Setra Model 231RS wet-to-wet multi-range differential pressure transducer with remote-wired sensors may be used.

C. Differential-pressure monitoring shall be analog-output type unless otherwise specified. High output, low differential pressure transducer designed for wet-to-wet differential pressure measurements of liquids or gases. A fast-response capacitance sensor and signal conditioned electronic circuitry provide a highly accurate, linear analog output proportional to pressure. Both unidirectional and bidirectional pressure ranges are available for applications with line pressure up to 250 psig.

D. An isolation system transmits the motion of the differential pressure sensing diaphragm from the high line pressure environment (for example, corrosive liquids) to the dry (air) enclosure where it moves one of a pair of capacitance plates proportionally to the diaphragm movement. Response to pressure changes is approximately 20 times faster than conventional fluid-filled transducers. The electronic circuit linearizes output vs. pressure and compensates for thermal effects of the sensor.

E. NEMA 4/IP65 rated enclosure. Pipe-thread fittings.

F. Accuracy RSS (of non-linearity, non-repeatability and hysteresis) (at constant temperature) +/- 0.25 percent of full scale (pressure range).

G. Pressure Range: Selected by the Contractor for the anticipated or field-measured (actual) pressure differential. Lower ranges have greater accuracy.

H. Ambient Operating Temperature for Electronics: 0 to 175°F.

2.17 DIFFERENTIAL WATER PRESSURE SWITCHES

A. Differential-pressure switches with on/off contact closure output may be used where specified.

B. NEMA 2 minimum enclosure. Pipe-thread fittings. Brass or bronze wetted parts.

C. Ambient Operating Temperature for Electronics: 30 to 158°F.

2.18 REFRIGERANT LEAK DETECTORS

A. Rated for use with A2L (mildly flammable, low toxicity) refrigerants of the types used in installed HVAC equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply and data outlet is available to control units and operator workstation.

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Wiring and conduits shall be properly supported and run in a neat and workmanlike manner. Wiring and conduits exposed and in equipment rooms shall run parallel to or at right angles to the building structure. Wiring and conduits within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. Wiring, conduits, wall boxes, and accessories shall conform to Division 26 – Electrical of the Contract Documents.

B. The ATC Subcontractor shall be responsible for electrical installation, including any low voltage and line voltage wiring which is required for a fully functional control system and not indicated on the Electrical Drawings or required by the Division 26 Electrical Specifications.

C. Wiring shall be in accordance with local and national Codes and regulations.

D. Provide electrical materials and installation under this Section. Requirements and standards shall be as specified in other Sections and Divisions of the Specifications, as indicated in paragraphs below.

1. Install raceways, boxes, and cabinets in conformance to Division 26.
2. Install building wire and cable in conformance to Division 26.
3. Provide interface wiring (line and low voltage) as required to complete ATC system installation.
4. Install signal and communication cable according to Division 26.
    a. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
    b. Install exposed cable in raceway.
    c. Install concealed cable in raceway.
    d. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
    e. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
    f. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
    g. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

E. Control wiring in mechanical rooms basement, and storage rooms, and where exposed, shall be installed in conduit or other raceways which shall comply with the requirements of the

Division 26 Electrical Specifications.

F. Electronic low-voltage wiring shall be #18 AWG minimum THHN and shielded if required.

G. Provide power for normally-open hot water valves serving heat exchanger, duct coil, blower coils, cabinet unit heater, kickspace heater, wall heaters, hydronic baseboard, and fintube from a central source(s). Interlock with hot water pump(s) to de-energize valves when pump is de-energized.

H. Power for any temperature control panels required in addition to those indicated on the Drawings shall be the responsibility of this Section.

3.3 INSTALLATION

A. Wall mounted thermostats and temperature sensors shall be attached to an electrical wall box attached to a wall stud, masonry wall, or to blocking. Attaching to gypsum wallboard only shall not be allowed.

B. Mounting heights of room sensors, thermostats, and other devices, which have features which occupants may adjust or set by touching, shall be installed in locations and heights conforming to U.S. Department of Justice – 2010 ADA Standards for Accessible Design.

1. Unobstructed Forward or Side Reach: Reaches, measured by distance above the finished floor or ground surface upon which the occupant shall be sitting or standing, shall be a high of 48 inches maximum measured to the top of the device, and a low of 15 inches minimum measured to the bottom of the device.
2. Obstructed High Reach: Where a high forward reach is over an obstruction, the clear floor space shall extend beneath the element for a distance not less than the required reach depth over the obstruction. The high forward reach shall be 48 inches maximum where the reach depth is 20 inches maximum. Where the reach depth exceeds 20 inches, the high forward reach shall be 44 inches maximum and the reach depth shall be 25 inches maximum.
3. Coordinate with Division 26 – Electrical to match heights for an aesthetically pleasing appearance.

C. Verify location of room temperature sensors and other exposed control sensors with Drawings and room details before installation.

1. Thermostats and temperature sensors are indicated on the Drawings for general location. Terminal heat transfer units and fans which control space temperature shall be provided with thermostatic control, whether or not a thermostat or temperature sensor has been indicated on the Drawings.
2. Locate in the general location indicated, and coordinate to group together with room light switches and other devices of similar height, to minimize disruption of open wall space.
3. Locate to not be above electrical dimmers.
4. Locate to avoid heat-generating equipment such as computers, copiers, cooking equipment, coffee makers, vending machines, and refrigerators. Where electrical outlets are indicated near sensors, verify whether equipment is intended.
5. Locate to avoid heating piping which may be concealed in partitions.
6. Locate away from windows and exterior doors.

7. Locate to avoid other false sources of heat such as strong sunlight.

D. At each wall-mounted temperature sensor, provide wiring for setpoint dial and override pushbutton, and for communications jacks, whether or not the specified sensor has these functions. This will allow the Owner to change sensors to add these functions in the future. Provide access to the associated controller and related control panels through each communication jack.

E. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

F. Install freezestats serpentined across and clipped to the downstream face of coils. Entire length of capillary tube shall be within the unit airstream.

G. Perform adjustment/relocation of freezestats as required to eliminate nuisance freezestat alarms.

H. Aquastats shall be installed with adjustment knobs facing toward viewers to facilitate adjustment.

I. Outdoor air temperature sensor(s) shall be installed on the North side of the building.

J. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

K. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

L. Connect lead-standby controls to lock out the failed or non-selected motor, to prevent simultaneous operation.

M. Connect lead-standby controls so that only 1 motor can run in starter “hand” position.

N. Connect fire alarm shutdown of motors on the load side of controls and hand-off-auto switches, to prevent motor from running in any switch position during fire alarm.

O. For components to be installed under other Sections of the Specifications, provide delivery of components to appropriate Subcontractors, provide installation instructions, and supervise their installation.

P. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

1. Sensors shall be immersion type in wells unless otherwise specified or indicated.
2. Enlarge piping at wells to prevent excess interference with flow.
3. Locate wells to ensure insertion in active flowing section of piping or tank.
4. Fill sensor wells with Honeywell thermal heat transfer paste to ensure good conduction.

Q. Install automatic dampers in conformance to Division 23 Section "Air Duct Accessories."

R. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor

temperatures. Provide stand-off brackets of depth to meet or exceed specified thickness of duct insulation.

S. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

T. Provide labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

U. Unless otherwise indicated, actuators shall be spring loaded and shall, upon a loss of power, actuate their device to an appropriate “fail safe” position.

1. Hot water valves - fail safe to fully open.
2. Outside and exhaust air dampers - fail safe to fully closed.

V. Provide spring return actuators. “Floating point” actuators shall not be allowed.

W. Install software in control units and operator workstation(s). Implement features of programs to specified requirements and as appropriate to sequence of operation.

X. Connect and configure equipment and software to achieve sequence of operation specified.

3.4 FIELD QUALITY CONTROL

A. Coordinate with the requirements of Division 01 Section “General Commissioning Requirements”.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.

D. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check DDC system as follows:
   a. Verify that DDC controller power supply is from emergency power supply, if

applicable.
b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
c. Verify that spare I/O capacity has been provided.
d. Verify that DDC controllers are protected from power supply surges.

E. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make 3-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
   a. Check analog inputs at 0, 50, and 100 percent of span.
   b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
   c. Check digital inputs using jumper wire.
   d. Check digital outputs using ohmmeter to test for contact making or breaking.
   e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
   b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature set points.

C. 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 2 visits to Project during other than normal occupancy hours for this purpose.

D. Follow-Up Service for Special Collections Systems: During the 12 months after date of Substantial Completion, return to the site at 3, 6, 9, and 12 months to recalibrate and adjust the controls for these systems including but not limited to the Blower Coils, Condensing Units, Dehumidifiers, Heat Exchanger, and Glycol Pumps. Assist the Owner at each follow-up visit to adjust room temperature and humidity setpoints and trending frequency, to review trending data, and verify that fluctuations and drift in room conditions are within specified tolerances. The length of each visit shall be at least one 8-hour day. Provide at least 14 days advanced notice, and coordinate to ensure the Owner's selected staff member(s) can be on site.

3.6 VALIDATION

A. The ATC Subontractor shall completely check out, calibrate, and test connected hardware and software to ensure that the system performs in accordance with the approved submittals for specifications and sequences of operations.

B. Witnessed Validation Demonstration: Shall consist of:

1. Display and demonstrate each type of data entry to show site specific customizing capability.
2. Execute digital and analog commands.
3. Demonstrate ATC loop precision and stability via trend logs of inputs and outputs.
4. Demonstrate energy management performance via trend logs and command trace.
5. Demonstrate that each control point, tag, or address is associated with the proper device, such as a room sensor input or an actuator output. This demonstration shall include visual confirmation that the measured values and the output actions match what is indicated in the control system.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Mechanical instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

3.8 TRAINING

A. Training shall be by the ATC Subcontractor and shall utilize specified manuals and as-built documentation. Video record each training session, and turn the completed video over to the Owner when training has been completed.

B. Two four-hour training session shall be conducted at project substantial completion.

3.9 FOLLOW-UP SERVICE FOR SPECIAL COLLECTIONS

A. Follow-Up Service for Special Collections Systems: During the 12 months after date of Substantial Completion, return to the site at 3, 6, 9, and 12 months to recalibrate and adjust the controls for these systems including but not limited to the Blower Coils, Condensing Units, Dehumidifiers, Heat Exchanger, and Glycol Pumps. Assist the Owner at each follow-up visit to adjust room temperature and humidity setpoints and trending frequency, to review trending

data, and verify that fluctuations and drift in room conditions are within specified tolerances. Perform adjustments and repairs as necessary, and as requested by the Owner. The length of each visit shall be at least one 8-hour day. Provide at least 14 days advanced notice, and coordinate to ensure the Owner's selected staff member(s) can be on site.

PART 4 - SEQUENCE OF OPERATION

4.1 GENERAL

A. Submittals shall include detailed descriptions of system functions in the Contractor's own words; simple repetition or paraphrasing of the sequences specified herein will not be acceptable. In particular, the Special Collections Climate Controlled Storage Rooms sequences shall describe in detail the programming methods used to achieve the maximum daily fluctuations and drift of room conditions.

B. Setpoints shall be adjustable by the building operator through the graphic interface on the operator's workstation, and through a portable laptop computer plugged into the system at locations throughout the building.

C. Provide the ability for the Testing and Balancing Agent to connect to the system and change setpoints, to temporarily override setpoints, and to override modes of operation, as may be required for their work.

4.2 ALARMS

A. In addition to alarms specified in the following sequences, provide alarms as follows. Program alarms selected by the Owner to initiate a signal to the Owner's off-site building security company, and to designated agents such as company employees.

1. Room low temperature alarm.
2. Room high temperature alarm.
3. Room humidity alarm.
4. Boiler failure alarm.
5. Pump failure alarm (both pumps in lead-standby situations).

4.3 TRENDING

A. Provide trending of, and operator workstation access to, data as specified for operator station display for control sequences, and as otherwise indicated. Trending shall record data for suitable lengths of time, but not less than 1 year, and at suitable intervals.

4.4 OCCUPIED/UNOCCUPIED MODE

A. Provide as a minimum the following zones of occupied/unoccupied control, each with its own time-of-day and calendar sequences:

1. Office areas and lobby.
2. Conference Room.

B. When occupied/unoccupied override buttons on space sensors are pressed, the mode for that space and Energy Recovery Ventilator shall change to occupied mode for 2 hours (adjustable). System shall maintain a log of where and when the buttons are pressed during unoccupied times, but shall not log if button is pressed during occupied time.

C. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:

1. Calendar and time settings.
2. Mode status.
3. Identification of room where button was pressed.
4. Identification of systems in override status.
5. Override time remaining.
6. Trending:
   a. Mode status.
   b. Overrides.

4.5 HEATING MODE

A. Heating Mode is automatically enabled when outside air temperature drops below setpoint (60°F, adjustable) or when there is a call for heating from any 2 (quantity adjustable) zones or more, or from the low-temperature alarm in any space. Heating mode is automatically disabled when the outside air temperature rises above setpoint.

B. Heating control valves are powered from a dedicated circuit. When the hot water pumps are disabled, control power to the valves is de-energized, allowing the valves to go to failsafe position. This is to prolong actuator life by turning them off in warm weather.

4.6 DEADBAND

A. Deadband (Zero-Energy Mode): In spaces and systems with both heating and cooling setpoints, there shall be a difference of at least 4°F between temperature setpoints, unless otherwise specified. When the sensed temperature is between the heating and cooling setpoints, the system shall operate with no heating or cooling except as required to maintain the status quo.

B. The exception to this is the Special Collections Climate-Controlled Storage rooms 103 and 214, which shall be maintained within the specified narrow ranges of fluctuation and drift.

4.7 HEATING SUPPLY WATER TEMPERATURE CONTROL

A. Gas-fired hot water boiler and boiler pump are operated independently of any other system controls.

1. The boiler's outdoor-air reset controller senses the leaving supply water temperature and the outdoor air temperature, and resets the supply temperature setpoint based on the outdoor air temperature. Initial reset curve selection includes a supply temperature range of 120 to 160°F over an outdoor range of 0 to 55°F.
2. When the boiler is energized, its gas burner fires (fully modulating) to maintain the reset supply setpoint.

3. Whenever an existing or new heating zone calls for heating, the boiler and boiler pump are energized. The boiler pump starts and runs at a modulating speed as directed by the boiler's integral pump speed controller. When the water flow switch proves adequate flow, the boiler's gas burner is enabled. The boiler performs its startup procedures prior to firing the burner.
4. Boiler safeties including integral and pipe-mounted low water cutoffs, flame failure, vent temperature limit, and low airflow disable the boiler, and generate an alarm signal.
5. The alarm signal is connected to the ATC system, and to a local audible/visual alarm device with silencing button.

4.8 EXISTING ZONE PUMPS

A. Controls for existing zone pumps remain in place.

4.9 HOT WATER CIRCULATING PUMPS (HWP-1 & 2)

A. Pumps are started and stopped through the ATC system. The lead pump runs continuously in heating mode.

B. The integral speed controller modulates pump speed as necessary.

1. The ATC system monitors pump status, and other data. If a pump integral controller, differential pressure sensor, or current transformer indicates trouble, an alarm is generated. If the lead pump indicates trouble, the lead pump is locked out and the standby pump is energized.

C. An automatic lead-standby controller alternates lead pump operation on a weekly basis. The operator workstation also provides a manual selection of the lead pump. If the lead pump fails, that pump is locked out in both "Hand" and "Auto" modes (manual reset), the standby pump is automatically energized, and an alarm is generated at the operator workstation. If the standby pump also fails, a critical alarm is generated at the operator workstation, and an audible and visual alarm with silencing button is energized near the pumps.

D. Differential pressure sensors at each pump monitor pump operation and generate an alarm if differential pressure falls below minimum set point, with time delay on start-up and lead pump switch-over. If the lead pump fails for 15 seconds or more on initial startup, the lead pump is locked out in both Hand and Auto positions, the standby pump starts, and an alarm is sent to the ATC. Current sensors or pump integral controllers may be used instead of differential pressure sensors.

E. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:

1. Circulating Pumps HWP-1 & 2:
   a. Heating system and pump demand on/off.
   b. Lead/standby pump selection status.
   c. Lead/standby pump manual selection.
   d. Pump status by differential pressure or other means.
   e. Lead pump trouble (alarm).
   f. Both pumps failure (critical alarm).

g. Pump run time in hours.
h. Alarm silencing.

2. Trending:
a. Circulating pump operation.
b. Circulating pump lead/standby status.

4.10 GLYCOL CIRCULATING PUMPS (GP-1 & 2)

A. Pumps are started and stopped through the ATC system. The lead pump runs continuously.

B. The integral speed controller modulates pump speed as necessary.

1. The ATC system monitors pump status, and other data. If a pump integral controller, differential pressure sensor, or current transformer indicates trouble, an alarm is generated. If the lead pump indicates trouble, the lead pump is locked out and the standby pump is energized.

C. An automatic lead-standby controller alternates lead pump operation on a weekly basis. The operator workstation also provides a manual selection of the lead pump. If the lead pump fails, that pump is locked out in both “Hand” and “Auto” modes (manual reset), the standby pump is automatically energized, and an alarm is generated at the operator workstation. If the standby pump also fails, a critical alarm is generated at the operator workstation, and an audible and visual alarm with silencing button is energized near the pumps.

D. Differential pressure sensors at each pump monitor pump operation and generate an alarm if differential pressure falls below minimum set point, with time delay on start-up and lead pump switch-over. If the lead pump fails for 15 seconds or more on initial startup, the lead pump is locked out in both Hand and Auto positions, the standby pump starts, and an alarm is sent to the ATC. Current sensors or pump integral controllers may be used instead of differential pressure sensors.

E. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:

1. Circulating Pumps GP-1 & 2:
a. Heating system and pump demand on/off.
b. Lead/standby pump selection status.
c. Lead/standby pump manual selection.
d. Pump status by differential pressure or other means.
e. Lead pump trouble (alarm).
f. Both pumps failure (critical alarm).
g. Pump run time in hours.
h. Alarm silencing.

2. Trending:
a. Circulating pump operation.
b. Circulating pump lead/standby status.

4.11 GLYCOL HEATING SYSTEM (HX, GMU)

A. The heat exchanger (HX) is enabled and disabled by the ATC system. The glycol makeup unit

(GMU) operates on its integral controls.

1. Heat Exchanger (HX):
   a. The HX is enabled continuously, to generate warm glycol supply..
   b. On a call for heat from a supply-pipe immersion temperature sensor (setpoint 140°F, adjustable) the 3-way normally-open hot-water control valve modulates open to the heat exchanger. On no call for heat, the valve is closed to the heat exchanger and open to the bypass.
2. Glycol Makeup Unit (GMU):
   a. The GMU pump cycles on the unit's integral pressure controller, to maintain fill pressure in the glycol piping system.
   b. The ATC system monitors the unit's controller for alarm signals.

B. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:

1. Heat Exchanger:
   a. Discharge temperature setpoint.
   b. Discharge temperature.
2. Glycol Makeup Unit:
   a. Alarm status.
3. Trending:
   a. Glycol supply temperature.
   b. GMU alarms.

4.12 BLOWER COILS (BC), CONDENSING UNITS (CU), HUMIDIFIERS (H), AND DEHUMIDIFIERS (DH) FOR CLIMATE-CONTROLLED SPECIAL COLLECTIONS STORAGE ROOMS 102 AND 214:

A. Controls maintain room temperature and relative humidity setpoints, with the following initial setpoints: 58°F and 40 percent RH (adjustable with temperature range of 45 to 65°F and humidity range of 35 to 45 percent). Control methods may include but are not limited to PID control. Maintain fluctuation and drift limits as follows, in accordance with National Information Standards Organization (NISO) standard TR01-1995:

1. Maximum Daily Fluctuations: Plus or minus 2 degrees F, plus or minus 3% RH.
2. Maximum Monthly Drift: 3 degrees F, 3% RH.

B. Space Temperature Sensor and Humidity Sensor: Wall-mounted, with blank cover. Located away from doorways and duct openings.

C. Space Display: Wall-mounted, with digital display of the ATC system's temperature and relative humidity readings. Locate inside or outside the Special Collections room where directed by the Owner's representative.

D. The Blower Coil fan is energized continuously. A current transformer or factory-mounted motor controller monitors fan operation. An airflow switch (see humidifier control sequence) also monitors airflow status.

E. Heating: The 3-way glycol water valve modulates to maintain setpoint.

F. Cooling:

1. The condensing unit cycles to maintain setpoint.
2. A “klixon” diaphragm temperature switch or sensor mounted on the cooling coil monitors the coil for defrost buildup. On sensing frost temperature, the condensing unit is deenergized, and the coil is defrosted by air motion. When the temperature increases above setpoint, the condensing unit is enabled and cycles normally.
3. The condensing unit’s integral controls modulate its compressor and fan speed.

G. Dehumidifier:

1. The dehumidifier’s process (room air) fan runs continuously. It draws a portion of its air from the room, and a portion from outdoors to provide ventilation and pressurization to the room.
2. The reactivation fan runs when the room requires dehumidification (or continuously if required by the manufacturer), drawing air from the surrounding storage room and discharging to outdoors. During dehumidification, controls integral to the unit modulate the desiccant wheel speed and the reactivation electric heater.
3. The factory-mounted controller has trouble and other alarm contacts or signals, which are monitored by the ATC system.

H. Humidifier: See “HUMIDIFIERS” paragraph below. Integrate humidifier control into control of other Special Collections rooms’ equipment for a unified system in each room.

I. Safeties:

1. Refrigerant detectors, located where directed by the equipment manufacturers based on calculations of potential refrigerant concentration in the rooms associated with the condensing unit and its piping, monitor the room air for refrigerant leaks. Upon sensing a leak, the condensing unit is shut down, and an alarm is generated in the ATC system.

J. At a minimum, indicate the following on operator workstation display terminal:

1. Supply fan command.
2. Supply fan status.
3. Room temperature and setpoint.
4. Room relative humidity and setpoint.
5. Cooling or heating mode.
6. Heating valve command.
7. Condensing unit command.
8. Dehumidifier alarm status.
9. Refrigerant leak.
10. Trending:
    a. Room temperature and humidity.
    b. Heating and cooling commands.
    c. Alarms.

4.13 HUMIDIFIERS

A. Sensors: Room humidity sensors are associated with the blower coil units - see blower coil

unit sequences. High-limit humidity sensor is installed in the ductwork downstream of the humidifier discharge manifold.

B. On a call for humidification, the factory-mounted controls cycle the modulating electric heating, water makeup solenoid valve, and other controls to maintain humidity setpoint. Safeties include high temperature limit switch, airflow proving switch, and low water cutoff switch.

C. Factory-mounted controls provide tank temperature sensing, timed automatic flushing, and other functions. Drain water is tempered by a drain cooler with mechanical controls, activating a cold water valve to limit the discharge temperature.

D. Provide connection to the humidifier's controller, which is specified to have ModBus and BACnet communication capability. Using this connection, the ATC is capable of remote monitoring and control.

E. Provide a water sensor in the drip pan receiver, and another on the floor, at each humidifier to monitor for leaks.

F. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:

1. Room humidity and setpoint.
2. Supply duct high humidity sensor status and setpoint.
3. Airflow switch status.
4. Humidifier on/off command.
5. Trouble alarm.
6. Water leak sensor status.
7. Trending:
    a. Room humidity.
    b. Humidifier on/off.
    c. Airflow status.
    d. Trouble alarm.
    e. Leak sensors.

4.14 ENERGY RECOVERY VENTILATOR (ERV) AND DUCT COIL (DC)

A. The ERV is enabled in the occupied mode, and disabled in the unoccupied mode.

B. When ERV operation is enabled, the motorized dampers in the outdoor air and exhaust ducts open. When the auxiliary switches on the dampers both prove the dampers nearly open, the ERV fans start and run continuously.

C. A supply duct insertion averaging temperature sensor or modulating thermostat located 4 to 6 feet downstream of DC-1 activates the 3-way control valve on a call for heat (setpoint 68 degrees F, adjustable). The valve modulates to maintain the setpoint. When the setpoint is satisfied, the valve closes fully.

D. An automatic-reset freezestat (setpoint 40 degrees F, adjustable) opens the 3-way valve fully until the freezestat is satisfied, regardless of whether the ERV is activated.

E. A manual-reset freezestat (setpoint 32 degrees F, adjustable) serpentined across the downstream face of DC-1 disables the ERV, closes the outdoor air and exhaust dampers, opens the 3-way valve to full heating position, and activates an audible/visual alarm with silencing switch, located in a ground-floor space where directed by the Owner's representative.

F. When ERV operation is disabled the ERV fans stop, the dampers close, and the heating valve closes.

G. Filter Pressure Drop Monitoring: Filter differential-pressure switches or sensors monitor the pressure drop across the filters, and generate an alarm when the filters are dirty.

4.15 BASEBOARD AND FINTUBE RADIATION

A. Space Sensor: Wall-mounted, with occupied/unoccupied override button.

B. Space sensor cycles 2-position control valve to maintain room temperature (setpoint 68°F occupied/60°F unoccupied, adjustable).

C. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:

1. Space temperature.
2. Valve on/off command.
3. Trending:
    a. On/off command.

4.16 CABINET UNIT HEATER, WALL HEATER, KICKSPACE HEATER (CUH, WH, KH)

A. Space sensor: Wall-mounted.

B. Setpoint: Provide occupied/unoccupied control. Initial setpoints (adjustable):

1. Cabinet Unit Heaters: 65°F occupied/55°F unoccupied.
2. Wall and Kickspace Heaters: 68°F occupied/60°F unoccupied.

C. 2-position control valve opens on demand from space sensor, and strap-on return aquastat cycles the fan. Provide strap-on aquastat set at 110°F to 120°F to prevent fan operation when hot water is not available; for wall and kickspace heaters the aquastat may be a fixed-setpoint device factory-furnished on the coil or at the coil return connection. Insulate over the sensor bulb.

D. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:

1. Space temperature.
2. Unit on/off command.
3. Trending:
    a. On/off command.

4.17 HEAT PUMP, DUCTED SINGLE ZONE (Elevator Hoistway)

A. A hard-wired wall-mounted controller cycles the indoor unit with programmed occupied/unoccupied times and dates. A remote temperature sensor in the elevator hoistway is the sensor used; any sensors in the indoor unit or wall controller are disabled. Room setpoints (adjustable) for occupied and unoccupied times, and for heating and cooling with deadband, are programmed in cooperation with the Owner's representative, and as required to satisfy the requirements of the elevator manufacturer. Controls within the indoor unit signal to the outdoor unit to obtain heating or cooling as necessary.

B. Monitoring: ATC-system monitor system's BACnet interface module.

C. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:

1. Space temperature.
2. System trouble alarm.
3. Trending:
    a. Space temperature.

4.18 DUCTLESS SPLIT SYSTEMS AND MINI-SPLIT SYSTEMS

A. The factory-furnished hard-wired wall-mounted controller cycles the indoor fan on a call for cooling (setpoint 75°F, adjustable). The outdoor unit compressor and its condenser fan cycle as required. The Mechanical Subcontractor is responsible for controller setup and programming.

B. Monitoring: ATC-system monitor system's BACnet interface module.

C. Operator Station Display: At a minimum, indicate the following on operator workstation display terminal:

1. Space temperature.
2. System trouble alarm.
3. Trending:
    a. Space temperature.

END OF SECTION 230900

SECTION 231123 - FACILITY NATURAL-GAS 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. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Manual gas shutoff valves.
5. Motorized gas valves.
6. Pressure regulators.
7. Service meters.
8. Dielectric fittings.

1.3 DEFINITIONS

A. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Steel Support 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.

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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.9 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Construction Manager no fewer than four business days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Construction Manager's written permission.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames" Or Division 23 Section “Common Work Results for HVAC.”

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

a. Material Group: 1.1.
b. End Connections: Threaded or butt welding to match pipe.
c. Lapped Face: Not permitted underground.
d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

B. Drawn-Temper Copper Tube: Comply with ASTM B88, Type L.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.

a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.

b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.

C. Annealed-Temper Copper Tube: Comply with ASTM B88, Type K.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Flare Fittings: Comply with ASME B16.26 and SAE J513.

a. Copper fittings with long nuts.
b. Metal-to-metal compression seal without gasket.
c. Dryseal threads complying with ASME B1.20.3.

D. Tin-Lined Copper Tube: ASTM B280, seamless, annealed, with interior tin-plated lining.

1. Flare Fittings: Comply with ASME B16.26 and SAE J513.

a. Copper fittings with long nuts.
b. Metal-to-metal compression seal without gasket.
c. Dryseal threads complying with ASME B1.20.3.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Y-Pattern Strainers:

1. Body: ASTM A126, 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: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. 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.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

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.
2. Body: Bronze, complying with ASTM B584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.

7. Ends: Threaded, flared, or socket as indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.

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.Y. McDonald Mfg. Co.
2. Body: Bronze, complying with ASTM B584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

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. Dormont; A Watts Water Technologies Company.
   b. Maxitrol Company.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.

7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

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. Dormont; A Watts Water Technologies Company.
    b. Maxitrol Company.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 1 psig.

2.7 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. Manufacturers: 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.Y. McDonald Mfg. Co.
    b. Capitol Manufacturing Company.
    c. Matco-Norca.
2. 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.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Capitol Manufacturing Company.
   b. Matco-Norca.
2. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

C. Install fittings for changes in direction and branch connections.

D. Install pressure gage downstream from each service regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

    a. Exception: Tubing passing through partitions or walls does not require striker barriers.

3. Prohibited Locations:

    a. Do not install natural-gas piping in or through circulating air ducts, chimneys or gas vents (flues), ventilating ducts, or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

W. 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."

X. 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."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install anode for metallic valves in underground PE piping.

3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for corrugated stainless-steel tubing, 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.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of steel piping and copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of corrugated stainless-steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.10 PAINTING

A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (semigloss).
d. Color: Gray.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (semigloss).
d. Color: Gray.

2. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (semigloss).
d. Color: Gray.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.Practical size limit for copper is NPS 4 (DN 100) because joints are difficult to heat evenly for brazing.

B. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves at service meter shall be bronze plug valves.

B. Distribution piping valves shall be two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123

SECTION 232113 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings For:
   1. Heating water piping system.
   2. Glycol water piping system.
   3. Equipment drains and overflows.

B. Valves:
   1. Globe or angle valves.
   2. Ball valves.
   3. Butterfly valves.
   4. Check valves.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Access Doors.

1.3 RELATED SECTIONS

A. Division 09 Section “Interior Painting.”

B. Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”

C. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

D. Division 23 Section “Identification for HVAC Piping and Equipment.”

E. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

F. Division 23 Section “HVAC Piping Insulation.”

G. Division 23 Section “Hydronic Specialties.”

H. Division 23 Section “HVAC Water Treatment”: Pipe cleaning.

1.4 REFERENCES

A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

B. ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

E. ASME B31.5 - Refrigeration Piping.

F. ASME B31.9 - Building Services Piping.

G. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.

H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

I. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

J. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

K. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

L. ASTM A403 - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.

M. ASTM B32 - Solder Metal.

N. ASTM B88 - Seamless Copper Water Tube.

O. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.

P. ASTM D1785 - Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

Q. ASTM D2235 - Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

R. ASTM D2241 - Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).

S. ASTM D2310 - Machine-Made Reinforced Thermosetting Resin Pipe.

T. ASTM D2466 - Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

U. ASTM D2467 - Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

V. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite-Sewer Piping.

W. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

X. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

Y. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and

Fittings.

Z. ASTM D3309 - Polybutylene (PB) Plastic Hot-and Cold-Water Distribution Systems.

AA. ASTM D3965 - Standard Classification System and Basis for Specifications for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings.

BB. ASTM F441 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

CC. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

DD. ASTM F845 - Plastic Insert Fittings for Polybutylene (PB) Tubing.

EE. AWS A5.8 - Brazing Filler Metal.

FF. AWS D1.1 - Structural Welding Code.

GG. NSF/ANSI 14 – Plastic Piping System Components and Related Materials.

HH. NSF/ANSI 61 - Drinking Water System Components.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide Manufacturers catalogue information. Indicate valve data and ratings.

C. Welders Certificate: Include welder’s certification of compliance with ASME SEC 9 and AWS D1.1.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

B. Record actual locations of valves.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section

with minimum 3 years' experience.

B. Installer: Company specializing in performing the work of this Section with minimum 3 years' experience.

C. Welders: Certify in accordance with ASME SEC 9 and AWS D1.1.

D. Pressed Pipe Fittings: Submit documentation of fitting-manufacturer training of installers or their on-site supervisors, with names of individuals.

1.9 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section "Product Requirements."

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 HEATING WATER AND GLYCOLPIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53, Schedule 40, black.
   1. Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.
   2. Joints: Schedule 40 threaded for pipe sizes 2 inch and smaller, and AWS D1.1, welded for pipe sizes over 2 inch.
   3. Grooved and Shouldered Pipe End Couplings: As specified in this Section, with grooved

steel pipe, is an acceptable alternate to the above for water service operating at temperatures from -30 to 230 degrees F, utilizing grade E, EPDM gasket compound.

B. Copper Tubing: ASTM B88, Type L hard drawn.
1. Allowed only for pipe sizes 2 inch and smaller.
2. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
3. Joints: Solder or braze, or press fittings.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.
1. Fittings: Galvanized cast iron, or ASTM B16.3 malleable iron.
2. Joints: Threaded, or grooved mechanical couplings.

B. Copper Tubing: ASTM B88, Type L, hard drawn.
1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder or braze, or press fittings.

C. Stainless Steel Pipe with Press Fittings: See paragraph titled “Press Fittings and Stainless Steel Piping Systems” in this Section.

D. PVC Pipe: ASTM D1785, Schedule 40, and Schedule 80 for sizes 8 inch (200 mm) and larger, or ASTM D2241, SDR 21 or 26.
1. Fittings: ASTM D2466, D2665 or D2467, PVC.
2. Joints: ASTM D2855, solvent weld.

2.3 BRAZING MATERIALS – 15 percent Silver for copper, brass, and bronze

A. Manufacturers:
1. Harris (Product: Stay-Silv 15).
2. Lucas-Milhaupt (Product: Silvaloy 15).
3. No substitutions.

B. Nominal Composition: 5.0 percent phosphorus, 15.0 percent silver, 0.15 percent other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:
1. Color: Yellow/Gray
2. Solidus: 1190 degrees F
3. Liquidus: 1480 degrees F
4. Brazing Range: 1300 – 1500 degrees F
5. Electrical Conductivity: 9.9 percent IACS
6. Electrical Resistivity: 17.40 Microhm-cm

D. Specification Compliance:
1. ANSI/AWS A5.8, class BCuP-5
2. ASME SFA5.8, class BCuP-5
3. Optional:
a. QQB 650C, class BCuP-5

b. QQB 654A, class BCuP-5
c. QQB 654, class BCuP-5

E. Flux:
1. Harris (Stay-Silv for copper-to-brass joints. No flux required for copper-to-copper joints).

2.4 BRAZING MATERIALS – 35 percent Silver for brazing to ferrous metals (steel)

A. Manufacturers:
1. Harris (Product: Safety-Silv 35).
2. Lucas-Milhaupt (Product: Silvaloy A-35).
3. No substitutions.

B. Nominal Composition: 35.0 percent silver, 33 percent Zinc, 0.15 percent other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:
1. Color: Yellow/Gray
2. Solidus: 1250 degrees F
3. Liquidus: 1410 degrees F
4. Electrical Conductivity: 19.8 percent IACS
5. Electrical Resistivity: 8.2 Microhm-cm

D. Specification Compliance:
1. ANSI/AWS A5.8, class BAg-5
2. ASME SFA5.8, class BCuP-5

E. Flux:
1. Harris (Stay-Silv white flux, or where heating cycles are extended, Stay-Silv black flux).

2.5 SOLDER MATERIALS:

A. Manufacturers:
1. Harris (Product: Stay-Brite).
2. Lucas-Milhaupt (Product: Silvabrite).
3. No substitutions.

B. Nominal Composition: Alloy of silver and tin (3-6 percent Ag, remainder Sn). Antimony-free.

C. Physical Properties:
1. Color: Bright Silver
2. Solidus: 430 degrees F
3. Liquidus: 430 degrees F
4. Electrical Conductivity: 16.4 percent IACS
5. Shear Strength: 10,600 psi
6. Tensile Strength: 14,000 psi
7. Elongation: 48 percent

D. Specification Compliance:
1. NSF 51
2. ASTM B32-89, Alloy Grade Sn96
3. Federal Spec. QQ-S-571E, Class Sn 96 with exception to QPL paragraph 3.1
4. J-STD-006, Sn96Ag04A

E. Flux:
1. Harris (Product: Stay Clean Paste Flux, Stay Clean Liquid Flux (used with 4 inch or larger copper tubing also stainless steels), or Bridgit Water Soluble Paste Flux).
2. Canfield (Product: Aqua-Brite or AB Cream Flux). Glycerin-based, water soluble.

2.6 UNIONS, FLANGES, AND COUPLINGS

A. Unions for Pipe 2 inch and Under:
1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 Inch:
1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Polypropylene Pipe:
a. Manufacturer: Aquatherm, Greenpipe product line, no substitutions.
4. Gaskets: 1/16 inch thick preformed neoprene or EPDM, reinforced as required for the system operating pressure, up to relief valve setting.

C. Grooved and Shouldered Pipe End Couplings:
1. Approved Manufacturers:
a. Victaulic Company.
b. Anvil International (division of Mueller Water Products, Inc.) - Gruvlok product line.
2. Products:
a. Housing Clamps: Malleable iron to engage and lock, designed to permit some angular deflection, contraction, and expansion.
b. Sealing Gasket: C-shape EPDM elastomer composition for operating temperature range from -30 degrees F to 230 degrees F. This is the standard gasket material suitable for water and glycol service. For other services, verify material.
c. Accessories: Steel bolts, nuts, and washers with zinc plating.
3. Note: Grooved couplings are not allowed where concealed above hard ceilings.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 PRESS FITTINGS

A. Approved Manufacturers:
1. Viega LLC, Wichita, KS - ProPress System with Smart Connect feature – basis of design.
2. Apollo, division of Conbraco Industries – ApolloPress product line.
3. Mueller Industries – Streamline PRS product line.
4. Nibco Inc.

5. No substitutions.

B. Fitting and Valve Products:
1. Wrought copper and cast copper alloy (brass or bronze) fittings and valves for copper piping.
2. Adapter fittings for transition connections to threaded fittings and dissimilar materials.
3. Available sizes: 1/2 inch to 4 inch.

C. Features:
1. Seals: O-ring type, factory installed in a fitting bead. Seals in larger sizes shall include a separator ring and a stainless steel grip ring.
2. Seal Materials: EPDM (color shiny black) for hydronic, potable water, and drain systems. HBNR (color yellow) in copper fittings for fuel oil, diesel fuel, fuel gases, and compressed air systems.
3. Colored Identification Dots:
   a. Green for EPDM seal.
   b. Yellow for ProPressG fittings with HNBR seal.
4. Smart Connect feature provides a leakage path to allow water and air to leak past any unpressed connection, for quick identification during pressure testing.

D. Temperature/Pressure ratings (with appropriate type seals):
1. Hydronic Systems: 0 to 250 degrees F up to 200 psig, at up to 100 percent maximum concentration of ethylene or propylene glycol.
2. Fuel Gases: -40 to 160 degrees F ambient, up to 125 psig.

E. Accessories:
1. Pressing: Use pressing tools, actuator jaws, and pressing rings, Ridgid brand manufactured by Ridge Tool Company, as recommended by the fitting manufacturer for each type of fitting.
2. Lubricants: Do not use. Not recommended by fitting manufacturer.
3. Cutting Tools: For copper or stainless steel pipe, use wheeled cutting tool, or cutting tool approved by the fitting manufacturer. Use deburring tool or reamer after cutting.

2.8 PIPE HANGERS AND SUPPORTS

A. See Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

2.9 SLEEVES

A. See Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”

2.10 VALVES

A. Manufacturers:
1. Anvil International - Gruvlok product line.
2. Apollo.
3. Hammond.
4. Keckley Co. – silent and wafer check valves.
5. Milwaukee.

6. Nibco Inc.
7. Victaulic Company.
8. Watts.
9. Wheatley.
10. No substitutions.

B. Gate Valves Over 2 inch:
1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.
2. 125 lb S.W.P., 200 lb W.O.G.

C. Globe or Angle Valves:
1. Up To and Including 2 inch:
   a. Bronze body, bronze trim, screwed or union bonnet, rising stem and handwheel, inside screw, renewable composition disc and bronze seat, solder or threaded ends.
   b. 150 lb S.W.P., 300 lb W.O.G.
2. Over 2 inch :
   a. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.
   b. 125 lb S.W.P., 200 lb W.O.G.

D. Ball Valves:
1. Up To and Including 3 inch:
   a. Bronze two or three piece body, full port, chrome plated brass ball, teflon seats and stuffing box ring, lever handle, solder or threaded ends.
   b. 150 lb S.W.P., 600 lb W.O.G.
2. 2-1/2 inch and Larger:
   a. Cast steel body, conventional port, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.
   b. 150 lb S.W.P., 285 lb W.O.G.
3. Stem Extensions: Provide ball valves in insulated piping with stem extensions to allow for continuous thickness of field-installed insulation.

E. Butterfly Valves:
1. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
2. Disc: Aluminum bronze or chrome plated ductile iron.
3. Operator: 10 position lever handle for shut-off service, infinite position lever handle with memory stop for throttling service.
4. Pressure rating shall be 150 psi at 225 degrees F.

F. Swing Check Valves:
1. Up To and Including 2 inch: Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.
2. Over 2 inch: Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

G. Spring Loaded Check Valves: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. Refer to Division 23 Section “HVAC Water Treatment.”

3.2 INSTALLATION

A. Install in accordance with Manufacturer's instructions.

B. Install components furnished under other Section and Divisions of the Specifications. Such items may include but are not limited to: Sensors furnished under Division 23 Section “Instrumentation and Control for Mechanical Systems.”

C. Install heating waterand glycol piping to ASME B31.9.

D. Pipe used shall be new material, and threads on piping shall be full length and clean cut with inside edges reamed smooth to full inside bore.

E. Minimum pipe size allowed for hydronic piping shall be 3/4 inch. Piping less than 3/4 inch shall not be allowed for these piping systems.

F. Route piping in orderly manner, parallel to building structure, and maintain gradient.

G. Install piping to conserve building space, and not interfere with use of space.

H. Group piping whenever practical at common elevations.

I. Erect piping to provide for the easy passage and noiseless circulation of water under working conditions.

J. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level. Slope water piping 1 inch in 40 feet (1:480) and arrange to drain at low points. Slope piping up in direction of water flow.

K. On closed systems, equip low points with 3/4 inch drain valves and hose nipples. Provide, at high points of mains, collecting chambers and high capacity float operated automatic air vents, with ball valves on their inlets to valve off after initial system startup. Provide, at high points of branches, manual air vents with air chambers.

L. Use main sized saddle type branch connections for directly connecting branch lines to mains in steel piping if main is at least 1 pipe size larger than the branch.

M. Caulking of threads will not be allowed on any piping.

N. Pipe joint compound shall be put on male threads only.

O. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

P. Dissimilar Metals: Use non-conducting dielectric connections whenever jointing dissimilar metals. Cast red-brass (not yellow brass) or bronze-bodied fittings such as valves and couplings may be used when joining steel to copper, steel to stainless steel, or copper to stainless steel. Steel and stainless steel may connect directly to iron, but copper may not connect directly to iron.

Q. Where welded joints are required, steel piping shall be installed by the use of the oxyacetylene or electric welding process, except immediate connections to accessible equipment may be threaded. Piping shall have butt welds with welding fittings, standard factory fabricated tees, elbows, reducers, caps, and accessories. Branch outlets 2 inch and smaller shall be made by the use of approved welding type half-couplings, “Weldolet” or “Threadolet” fittings.
1. Piping smaller than 2 inch may be installed at the Contractor’s option with welding type, or threaded type fittings, except that piping regardless of size concealed in trenches or inaccessible building construction (for example, concealed behind sheetrock walls or concealed above sheetrock ceilings) shall be welded.
2. Offsets shall be installed with long radius welding elbows.
3. Welding shall be executed only by certified welding mechanics in accordance with the best practice of the trade.

R. Grooved Mechanical Couplings:
1. Use grooved mechanical couplings and fasteners in accessible locations only. Grooved mechanical couplings are not allowed in areas such as behind gypsum wallboard walls and above gypsum wallboard or wood ceilings.
2. Install in strict accordance with manufacturer’s instructions. Nothing in this Specification is intended to supersede manufacturer’s instructions and recommendations.
3. Prepare pipe ends properly, and check again before coupling installation.
4. Lubricate gaskets as recommended. Check gasket before installation.
5. Do not lubricate coupling mating surfaces (bolt pads) or bolt threads, because this might affect torque readings.
6. Verify that pipe-end separation (all couplings) and deflection from centerline (flexible couplings only) do not exceed manufacturer’s specifications. Separate pipe ends the maximum allowed amount to provide maximum expansion capability. Some systems operate at mixed temperatures (for example, cooling tower condenser water systems) and may require different spacing for different sections of the system, and/or a spacing somewhere between minimum and maximum in proportion to the need for expansion and contraction.
7. NOTE: Tighten nuts evenly by alternating sides until tightened to recommended torque.

Make sure the housings' keys completely engage the grooves. Make sure the offsets are equal at the bolt pads, during tightening and when fully tightened. NOTE: It is important to tighten nuts evenly to prevent gasket pinching.

a. Victaulic Couplings: On rigid couplings with angled bolt pads, pads will be offset when tightened. On flexible couplings, bolt pads will be in contact and aligned when tightened.
b. Anvil Couplings: On rigid couplings, bolt pads will have up to 1/16-inch gap when tightened. On flexible couplings, bolt pads will be in contact when tightened.

8. If an impact wrench or other power tool is used to tighten, use extra care. NOTE: Anvil International does not recommend use of impact wrenches with their Gruvlok products.
9. For couplings with manufacturer torque specifications, verify torque on each bolt. Do not exceed torque specification by more than 25 percent.

S. Sleeve pipe passing through partitions, walls and floors:
1. See Division 23 Section "Sleeves and Escutcheons for HVAC Piping."
2. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
3. Extend sleeves through floors as follows: In locations not otherwise indicated, 2 in. (50 mm) above finished floor level. In normally-dry locations such as finished office spaces under fintube and baseboard radiation, 1 in. above finished floor level. Finished floor level includes the thickness of floor finish materials such as carpet and tile. Caulk sleeves full depth and provide floor plate.
4. Where piping passes through floor, ceiling or wall, close off space between pipe sleeve and construction with non-combustible insulation or with approved firestopping material when penetrating fire rated floors, ceilings or walls. Provide tight fitting metal escutcheons on both ends of sleeves to prevent movement of sleeve during piping expansion. Escutcheons shall be sized slightly larger than outside diameter of piping and smaller than diameter of sleeve. Escutcheons shall be rigidly secured to walls.
5. Where piping passes through fire rated floors, ceilings or walls, close off space between pipe insulation and sleeve with approved firestopping material
6. Install chrome-plated escutcheons where piping passes through finished surfaces.

T. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Division 23 Section "HVAC Piping Insulation."

U. In the erection of mains, use special care in the support, working into place without springing or forcing, and proper allowance made for expansion.

V. Pipes shall be anchored, guided, and otherwise supported, where necessary, to prevent vibration or to control expansion.

W. Make such offsets as are shown and required to place the pipes and risers in proper position to avoid other work.

X. Take branch lines off bottom of mains or at 45 degree bottom angle, as space permits.

Y. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus

connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

Z. Install a sufficient number of unions or flanged fittings to facilitate making possible future alterations or repairs.

AA. Install concealed pipes close to building structure to keep furring to a minimum.

BB. Provide access where valves and fittings are not exposed.

CC. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

DD. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Division 09 Section "Interior Painting."

3.3 VALVES

A. Valve Type Selection:
1. Use gate, ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
2. Use globe, ball or butterfly valves for throttling, bypass, or manual flow control services.
3. Use OS&Y Gate Valves at boiler supply and return connection in accordance with applicable State Boiler Rules and Regulations.
4. Use N.R.S. Gate Valves for general shut-off service in heating system piping 4 inch and larger.
5. Use Bronze Globe Valves in throttling applications at control valve bypasses and in expansion tank connection.
6. Use Bronze Ball Valves for general shut-off service in heating and cooling system piping 3 inch and smaller and at heating terminal units 3 inch and smaller, including fin-tube radiation, unit heaters, convectors and fan coil units.
7. Use Combination Balancing, Flow Measuring and Tight Shut-off Valves at terminal heating and cooling units, zone branches and as indicated.
8. Use Bronze Ball Valves for drain valves with hose connections. Provide valve of size indicated; if size isn't indicated, provide at least 3/4 inch valve size. Provide outlet fitting for standard "garden hose" with 3/4 inch hose threads. Provide brass cap with retainer chain. Compression-type "boiler drain valves" are not allowed.

B. With the exception of valves which must be properly sized to ensure design flow rates (such as balancing valves), valves shall be line sized.

C. For isolation valves, control valves and balancing valves located above suspended ceilings and in areas that are not visible to building occupants (for example, mechanical rooms), provide yellow colored surveyors tape. Permanently attach tape to valve handles and run tape down to 10 inches above ceiling or 12 inches below valve handle where ceilings do not exist (for example, mechanical rooms).

D. Standard details for heating and cooling coils are based on single coil arrangements. For heating and cooling coils that are supplied in a split coil arrangement, with 2 or more individual

coils, provide additional piping and balancing valves at each coil to ensure that flow through each coil is proportional to the percentage of total coil face area that the coil occupies.

E. Install valves with stems upright or horizontal, not inverted.

3.4 CLEANING

A. After satisfactory completion of pressure tests, before permanently connecting equipment, strainers, and the like, clean equipment thoroughly, blow and flush piping for a sufficient length of time as directed, so that interiors will be free of foreign matter. Perform cleaning in the presence of an authorized representative of the Architect. Provide a minimum of 10 days notification to the Architect prior to system cleaning.

B. Fill, vent and circulate the system with approved solution in accordance with equipment (boiler, piping, coils, and others) manufacturer's recommendation, allowing it to reach design or operating temperatures. After circulating for 6 hours, drain the system completely and remove and clean strainer screens. Perform cleaning in the presence of an authorized representative of the Architect. Provide a minimum of 10 days notification to the Architect prior to system cleaning.

C. Fill and vent system as required.

D. Manually vent heat transfer units and high points of the system.

E. Adjust the pressure reducing valve to provide minimum of 5 psig pressure at the highest point of the system.

F. After system has been completely filled, start zone pumps and circulate cold water for a short time to dislodge small air bubbles, and return them to air extraction device.

G. Raise water temperature to 200 degrees F while operating pumps.

H. Stop pump and vent radiation and high points of the system. Normal operation may now be started at any time.

3.5 TESTING

A. No joint or section of piping shall be left untested.

B. Before testing piping systems, remove, or otherwise protect from damage, control devices, air vents, and other parts which are not designed to stand test pressures.

C. Test piping for leaks under 100 psig air pressure with soap suds prior to hydrostatic testing.

D. Test piping hydrostatically to 1-1/2 times the maximum systems operating pressure, but in no case to less than 75 psig, for at least 4 consecutive hours, during which time pressure shall remain constant without pumping.

E. Test and obtain Architect's approval before painting, covering, or concealing piping, including

swing joints.

END OF SECTION 232113

SECTION 232118 – HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air separators.

D. Strainers.

E. Combination fittings.

F. Flow indicators, controls, meters.

G. Combination valve assemblies.

H. Relief valves.

I. Glycol specialties.

1.2 RELATED SECTIONS

A. Division 23 Section “Meters and Gauges for HVAC Piping”: Test Ports.

B. Division 23 Section “Hydronic Piping.”

C. Division 23 Section “HVAC Water Treatment”: Pipe cleaning, and bypass (pot) feeder.

1.3 REFERENCES

A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

C. Submit inspection certificates for pressure vessels from authority having jurisdiction.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section “Product Requirements.”

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 MAINTENANCE SERVICE

A. Furnish service and maintenance of glycol system for 1 year from date of substantial completion.

B. Monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

PART 2 - PRODUCTS

2.1 EXPANSION TANKS, DIAPHRAGM TYPE

A. Manufacturers:
1. Flexcon Industries.

2. Amtrol.
3. Wilkins.
4. Wessels.

B. Construction: Drawn steel, painted finish, with flexible butyl rubber diaphragm sealed into tank. Tanks with less than 10 gallons shall be of inline design with male pipe thread connection; larger tanks shall have integral floor stand and female thread pipe connection. Rated working pressure as scheduled on the Drawings. -type air-charging fitting and protective cap, and field-furnished pressure gauge.

2.2 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Type:
1. Manufacturers:
   a. Bell & Gossett.
   b. Caleffi.
   c. Taco.
   d. Thrush.
   e. Wheatley.
2. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

C. Washer Type:
1. Manufacturers:
   a. Bell & Gossett.
   b. Caleffi.
   c. Taco.
2. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.3 AIR SEPARATORS

A. In-line Microbubble Air Separators with Magnet, 1-1/2 inches (38 mm) and Smaller Line Size:
1. Manufacturers:
   a. Caleffi.
   b. Flamco.
   c. Spirotherm.
2. Brass body, with venting mechanism components of stainless steel, EPDM, viton, brass, and engineered plastics. Tested for 150 psig operating pressure, 25 to 240 degrees F operating temperature, maximum recommended water velocity 5 fps, suitable for up to 50 percent glycol, straight-through inlet and outlet connections, top fitting for air vent, bottom fitting for expansion tank, with internal coalescing medium of stainless steel, copper, or PA66GF30 glass-reinforced polymer, and inlet and outlet screens and top filter as required to contain the coalescing medium. Fittings shall be NPT threaded.
3. Separator shall function on the coalescing principle. Manufacturer shall furnish

documentation demonstrating that separator removes air microbubbles as small as 18 microns.

4. Integral top-mounted float-type automatic air vent with hose-clamp or pipe-thread outlet. Vent shall be serviceable and replaceable. Provide integral or separate valve allowing the vent to be manually closed for its protection during startup and purging.
5. Neodymium magnet external or internal to the separator body, removable to enable discharge of trapped ferrous particles without disturbing the piping. Provide valves in piping as recommended by the manufacturer.

2.4 STRAINERS

A. Manufacturers:
1. Sarco.
2. Armstrong.
3. Barnes and Jones.
4. Bell & Gossett.
5. Flo-Fab.
6. Keckley Co.
7. Muesco.
8. Wheatley.

B. Size 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch: Flanged iron body for 175 psig) working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.5 COMBINATION PUMP DISCHARGE VALVES

A. Combination valves which include the features of check, shutoff, and flow measuring valves, commonly known as “Triple Duty”, “Multipurpose”, or “Multi-function” valves, are not allowed.

2.6 FLOW CONTROLS

A. Manufacturers:
1. Griswold Controls.
2. Armstrong.
3. Bell & Gossett.
4. Taco.
5. Watts.

B. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psig (24 kPa).

D. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

E. Accessories: In-line strainer on inlet and ball valve on outlet.

2.7 BALANCING VALVES AND COMBINATION BALANCING/SHUT-OFF VALVES.

A. Manufacturers:
1. Bell & Gossett.
2. Armstrong.
3. Flow Design, Inc.
4. Gerand.
5. Griswold Controls.
6. Mepco.
7. Nexus Valve.
8. Taco.
9. Tour and Andersson.
10. Watts.
11. Wheatley.

B. Valves shall conform to one of the following:
1. Fixed-Orifice Manual Balancing Valve: Calibrated, ball type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer with memory stop. Readout valves measure the pressure differential across the fixed orifice plate or venturi. Valve shall be designed for positive shut-off.
2. Variable-Orifice Manual Balancing Valve: Cast iron or bronze, globe style, balance valve with handwheel with vernier type ring setting and memory stop, readout valves equipped with integral check valves and gasketed caps. Readout valves measure the pressure differential across the variable opening between valve plug and valve seat. Valve shall be designed for positive shut-off. Drain valve may be furnished with this valve, and if positioned properly may be substituted for the separate drain valve indicated. [Caution if using this type valve: Because of hard ceilings throughout the building, valves must be inside the enclosure of most terminal heating units. Ensure that the valve can be installed concealed from view.]

C. [Cast iron, wafer type, orifice insert flow meter for 250 psig working pressure, with read-out valves equipped with integral check valves with gasketed caps.]

D. Size balancing valves to allow a reading of 2 to 5 ft wg pressure drop at design flow rates. Submittals shall include a chart of valve selections, indicating room number, terminal heating device tag, flow rate, pressure drop, and differential pressure reading.

E. Insulation: Valves may be furnished with prefabricated thermal insulation. Flame spread reading shall be 25 or less per ASTM E84. R-value shall be 4 hr-sq.ft- F/Btu or greater. Install in accordance with Division 23 Section “HVAC Piping Insulation.”

2.8 COMBINATION VALVE ASSEMBLIES

A. Manufacturers:
1. Flow Design, Inc.
2. Griswold Controls.
3. Nexus Valve.

B. Assemblies combining valves and accessories may be furnished in lieu of the individual components, provided that the components are in the arrangement indicated on the Drawings and conform to the individual Specifications. Examples include combinations of manual balancing valves, unions, pressure/temperature test ports, strainers, manual air vents, flexible hose connections, and shutoff valves.

2.9 RELIEF VALVES

A. Manufacturers:
1. Bell & Gossett.
2. Cash Acme.
3. Spence.
4. Taco.
5. Watts.
6. Wheatley.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

C. Factory set to relieve pressure.

2.10 GLYCOL SYSTEM

A. Glycol Makeup Unit: Plastic tank with integral electric pump and pressure controls, as scheduled on the Drawings.

B. Glycol Solution:
1. Manufacturers:
a. Dow Chemical Co.
b. No Substitutions.
2. Heat Transfer Fluid:
a. Dowfrost corrosion-inhibited propylene glycol, colorless, 96 percent propylene glycol, 4 percent performance additives. Recommended use temperature range: -50 degrees F to 250 degrees F.
3. Provide a glycol and water solution mixed by volume as indicated on the Drawings.
4. Water used in solution shall conform to glycol manufacturer’s requirements. Water shall have low levels (less than 25 ppm) of chloride and sulfate, and less than 50 ppm of hard water ions (Ca++, Mg++). Distilled or deionized water is recommended. If good quality water is unavailable, purchase pre-diluted solutions of fluid from the fluid manufacturer or from the distributor.
5. Provide containers of undiluted inhibited glycol as required to compensate for any water left in the system after initial flushing, testing, and draining.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain, and shutoff ball valve upstream of vent to shut the vent off after initial system startup.

E. Provide valved drain and hose connection on strainer blow down connection.

F. Provide separate check, balancing, and shutoff valves on discharge side of base mounted centrifugal pumps.

G. Provide balancing valves on water outlet from terminal heating and cooling units such as radiation, unit heaters, and fan coil units.

H. Ensure that balancing valves are installed with minimum upstream length of straight pipe as recommended by the manufacturer.

I. Ensure that balancing valves are installed with the readout valves fully accessible, including space required for insertion of metering probes.

J. Install combination valve assemblies to account for small offsets between coils connections and hard pipe connections. Assemblies shall not be installed in a manner that forms bends of more than 90 degrees total.

K. Expansion Tanks (New and Existing): Provide pressure gauge per Division 23 Section “Meters and Gauges for HVAC Piping” in system near point where expansion tank is connected to system, for determining required pre-charge pressure for air side of expansion tank. Isolate expansion tank from system and pre-charge air side of tank to same pressure as static head of system at point where expansion tank is connected to system. Measure static head of system after pressure reducing valve at cold water make-up, or glycol makeup unit, has been properly set in accordance with this Section. Pre-charge air side of expansion tank only when the temperature of the water in the system is less than 80 degrees F. Provide drain valve with hose end connection at point of connection to expansion tank to allow for periodic removal of system pressure in order to check expansion tank’s pre-charge air pressure. Drain valve shall be located closest to expansion tank, isolation valve shall be immediately upstream of drain valve and pressure gauge shall be within sight upstream of isolation valve.

L. Relief Valves:
1. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
2. Select system relief valve capacity so that it is greater than make-up pressure reducing

valve capacity. Select equipment relief valve capacity to not exceed maximum pressure rating of connected equipment.

3. Pipe relief valve outlet to nearest floor drain or indirect waste receiver.
4. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

M. Glycol Systems:

1. Clean and flush glycol system before adding glycol solution. Refer to Division 23 Section "HVAC Water Treatment."
2. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Pressurize system cold at 5 psig at the high point.
3. Perform tests determining strength of glycol and water solution and submit written test results.

END OF SECTION 232118

SECTION 232123 – HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. In-line circulators.

1.2 RELATED SECTIONS

A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”

B. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

C. Division 23 Section “HVAC Piping Insulation.”

D. Division 23 Section “HVAC Equipment Insulation”

E. Division 23 Section “Hydronic Piping.”

F. Division 23 Section “Hydronic Specialties”

G. Division 26 “Electrical” Electrical characteristics and wiring connections.

1.3 REFERENCES

A. UL 778 - Motor Operated Water Pumps.

B. NFPA 70 - National Electrical Code.

1.4 PERFORMANCE REQUIREMENTS

A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading throughout the entire operating range in parallel or individual operation, and operate within 25percent of midpoint of published maximum efficiency curve.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Millwright's Certificate: Certify that base mounted pumps have been aligned.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing, assembly, and field performance of pumps with minimum 3 years’ experience.

B. Alignment: Base mounted pumps shall be aligned by a qualified millwright.

1.8 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Pumps, General:
1. Taco.
2. Armstrong.
3. Bell & Gossett.
4. Grundfos.
5. Wilo.

2.2 GENERAL

A. Statically and dynamically balance rotating parts.

B. Construction shall permit complete servicing without breaking piping or motor connections.

C. Pumps shall operate at 1750 rpm unless indicated or specified otherwise.

D. Pump connections shall be flanged.

E. Wetted parts shall be compatible with circulated fluid.

2.3 CARTRIDGE CIRCULATORS

A. Type: Cartridge type circulator, in-line mounting, for 125 psig maximum working pressure, 230 degrees F maximum water temperature.

B. Casing: Cast iron with flanged pump connections.

C. Impeller: Non-Metallic

D. Shaft: Ceramic

E. Bearings: Carbon.

F. Motor: Impedance protected, single speed, permanent split capacitor.

2.4 CARTRIDGE CIRCULATORS WITH INTEGRAL SPEED CONTROLLER

A. Type: Cartridge type circulator, in-line mounting,

B. Working Conditions:
1. Working Pressure: 145 psig maximum.
2. Minimum Inlet Pressure: 6.5 psig at 194 degrees F.
3. Fluid Temperature: 230 degrees F maximum for short periods, 203 degrees F maximum for continuous operation.
4. Ambient Temperature: 32 to 104 degrees F .

C. Casing: Cast iron or stainless steel with flanged pump connections. Wet-varnished finish.

D. Impeller: Stainless steel, or non-metallic composite.

E. Shaft: Stainless steel, tungsten carbide, or aluminum oxide.

F. Bearings: Carbon, with aluminum oxide outer bearing ring, aluminum oxide or silicon carbide inner bearing ring, and stainless steel bearing plate.

G. Stator Housing: Aluminum, with EPDM O-rings.

H. Rotor: Permanent-magnet rotor, with leak-proof stainless steel rotor can.

I. Motor: Variable speed, electronically commutated, synchronous permanent magnet motor, with 3-lead Alpha snap-lock power plug at pump, and flexible power cord for field connection to junction box. Integral motor protection.

J. Speed Controller: Integral pump-mounted frequency converter. Pump speed calculated via a built-in induction coil on the stator winding. User interface with LED indicators and pushbuttons. External start/stop input dry contact. Selectable operating modes.

2.5 SYSTEM LUBRICATED CIRCULATORS

A. Type: Horizontal shaft, single stage, direct connected with multiple speed wet rotor motor for in-line mounting, for 140 psig maximum working pressure, 230 degrees F maximum water temperature.

B. Casing: Cast iron with flanged pump connections.

C. Impeller, Shaft, Rotor: Stainless Steel.

D. Bearings: Metal Impregnated carbon (graphite) and ceramic.

E. Motor: Impedance protected, single speed

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

C. Decrease piping from line size with long radius reducing elbows or reducers.

D. Pump inlet conditions shall be as recommended by the pump manufacturer to eliminate system effects.

E. Support piping adjacent to pump such that no weight is carried on pump casings. Provide necessary brackets or hanger supports as required to relieve the stress on the pumps and piping.

F. Provide line sized shut-off valve and strainer on pump suction, and properly sized soft seat spring-loaded check valve and balancing/flow-measuring/shutoff valve on pump discharge.

G. Install pump with a single pressure gauge piped to suction and discharge, with shutoff valves.

END OF SECTION 232123

SECTION 232300 – REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and Liquid Indicators.

D. Valves.

E. Filter-Driers.

1.2 RELATED SECTIONS

A. Division 09 Sections “Interior Painting” and “Exterior Painting.”

B. Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”

C. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

D. Division 23 Section “HVAC Piping Insulation.”

E. Division 23 Section “HVAC Equipment Insulation.”

F. Division 23 Section “Packaged Compressor and Condenser Units.”

G. Division 23 Section “Split System Air Conditioners.”

H. Division 23 Section “Instrumentation and Controls for Mechanical Systems.”

I. Division 26 “Electrical.”

1.3 REFERENCES

A. ARI 495 - Refrigerant Liquid Receivers.

B. ARI 710 - Liquid Line Dryers.

C. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers

D. ARI 750 - Thermostatic Refrigerant Expansion Valves.

E. ARI 760 - Solenoid Valves for Use With Volatile Refrigerants.

F. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

G. ASHRAE 34 - Number Designation of Refrigerants.

H. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

I. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

J. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes.

K. ASME B31.5 - Refrigeration Piping.

L. ASME B31.9 - Building Services Piping.

M. ASME SEC 8D - Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.

N. ASTM B88 - Seamless Copper Water Tube.

O. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

P. ASTM F405 - Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings.

Q. ASTM F667 - Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings.

R. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

S. AWS A5.8 - Brazing Filler Metal.

T. AWS D1.1 - Structural Welding Code, Steel.

U. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

V. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

W. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

X. UL 429 - Electrically Operated Valves.

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

B. Liquid Indicators:
1. Use line size liquid indicators in main liquid line leaving condenser.

2. Use line size on leaving side of liquid solenoid valves.

C. Valves:
1. Use service valves on suction and discharge of compressors.
2. Use gauge taps at compressor inlet and outlet.
3. Use gauge taps at hot gas bypass regulators and at filters and filter driers, inlet and outlet.
4. Use check valves on compressor discharge.

D. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

E. Permanent Filter-Driers:
1. Use in systems utilizing hermetic compressors.
2. Use filter-driers for each solenoid valve.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Product Data: Provide general assembly of specialties, including manufacturer’s catalog information. Provide manufacturer’s catalog data including load capacity.

C. Pipe Sizing Recommendations of Equipment Manufacturers:
1. Verify indicated pipe sizes with the manufacturers of the associated equipment. If manufacturer’s recommendations differ from the sizes indicated on the Drawings, submit recommendations to the Architect. The Architect will make the final determination of pipe sizes. Provide sizes per final determination at no additional cost to the Owner. In sizing piping, include modifications as required to affected items including but not limited to piping, valves, filters, other pipeline accessories, insulation, supports, sleeves, conduits, building openings, and building enclosures.
2. Submission of manufacturer’s recommendations, and equipment performance related to pipe sizing, is the Contractor’s responsibility.
3. Verify sizing prior to any preparation for piping installation.

D. Test Reports: Indicate results of leak test, acid test.

E. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

F. Submit welders’ certifications of compliance with AWS D1.1., and their assigned identification letters, numbers or symbols.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

B. Record exact locations of equipment and refrigeration accessories on record drawings.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this Section with minimum 3 years’ experience.

B. Design piping system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the place where the Project is located.

1.9 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

C. Welders Certification: In accordance with AWS D1.1. and state and local requirements.

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

E. Refrigerant Safety: Conform with ASHRAE 15, state and local codes and manufacturer’s requirements for safe handling to avoid exposure to workers or to occupants.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section “Product Requirements.”

B. Deliver and store piping and specialties in shipping containers with labeling in place.

C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

D. Dehydrate and charge components such as piping, seal prior to shipment, until connected into system.

1.11 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of Division 01 Section “Closeout Procedures.”

PART 2 - PRODUCTS

2.1 PIPING

A. Copper Tubing: ASTM B280, Type ACR hard drawn, degreased, nitrogen charged and sealed. Annealed (soft) tubing may be used only for short (6 feet or less) above-grade connections to valves and equipment.
   1. Fittings: ASME B16.22 wrought copper.
      a. Fittings shall be packaged and labeled for ACR use.
      b. Elbows: Use long-radius elbows wherever possible. Do not use 45-degree elbows, because they are more likely to break at their inner surface in refrigeration service.
   2. Joints:
      a. Braze, 15 percent silver for copper, brass, and bronze.
      b. Braze, 35 percent silver, for brazing to ferrous metals (steel).
      c. Solder (for use only at equipment and valve connections where required by the equipment manufacturer).
      d. Other: If a valve or equipment manufacturer recommends a joint material other than those specified, submit it for approval.
      e. Flux: Use as recommended by alloy manufacturer. Should not be needed for copper-to-copper brazed joints.

B. Copper Tubing to 7/8 inch OD: ASTM B88, Type K, annealed.
   1. Fittings: ASME B16.26 cast copper.
   2. Joints: Flared.

2.2 PIPE SUPPORTS AND ANCHORS

A. See Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

2.3 PIPE SLEEVES

A. See Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”

2.4 BRAZING MATERIALS - 15% Silver

A. Manufacturers:
   1. Harris (Product: Stay-Silv 15).
   2. Lucas-Milhaupt (Product: Silvaloy 15).
   3. No substitutions.

B. Nominal Composition: 5.0 percent phosphorus, 15.0 percent silver, 0.15 percent other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:

1.	Color:	Yellow/Gray
2.	Solidus:	1190 degrees F
3.	Liquidus:	1480 degrees F
4.	Brazing Range:	1300–1500 degrees F

5. Electrical Conductivity: 9.9 percent IACS
6. Electrical Resistivity: 17.40 microhm-cm

D. Specification Compliance:
1. ANSI/AWS A5.8, class BCuP-5
2. ASME SFA5.8, class BCuP-5
3. Optional:
   a. QQB 650C, class BCuP-5
   b. QQB 654A, class BCuP-5
   c. QQB 654, class BCuP-5

E. Flux:
1. Harris (Stay-Silv For copper-to-brass joints. No flux required for copper-to-copper joints).

2.5 BRAZING MATERIALS – 35 percent Silver

A. Manufacturers:
1. Harris (Product: Safety-Silv 35).
2. Lucas-Milhaupt (Product: Silvaloy A-35).
3. No substitutions.

B. Nominal Composition: 35.0 percent silver, 33 percent Zinc, 0.15 percent other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:
1. Color: Yellow/Gray
2. Solidus: 1250 degrees F
3. Liquidus: 1410 degrees F
4. Electrical Conductivity: 19.8 percent IACS
5. Electrical Resistivity: 8.2 microhm-cm

D. Specification Compliance:
1. ANSI/AWS A5.8, class BAg-5
2. ASME SFA5.8, class BCuP-5

E. Flux:
1. Harris (Stay-Silv white flux, or where heating cycles are extended, Stay-Silv black flux).

2.6 SOLDER MATERIALS:

A. Manufacturers:
1. Harris (Product: Stay-Brite).
2. Lucas-Milhaupt (Product: Silvabrite).
3. No substitutions.

B. Nominal Composition: Alloy of silver and tin (3-6 percent Ag, remainder Sn). Antimony-free.

C. Physical Properties:

1.	Color:	Bright Silver
2.	Solidus:	430 degrees F
3.	Liquidus:	430 degrees F
4.	Electrical Conductivity:	16.4 percent IACS
5.	Shear Strength:	10,600 psi
6.	Tensile Strength:	14,000 psi
7.	Elongation:	48 percent

D. Specification Compliance:
1. NSF 51
2. ASTM B32-89, Alloy Grade Sn96
3. Federal Spec. QQ-S-571E, Class Sn 96 with exception to QPL paragraph 3.1
4. J-STD-006, Sn96Ag04A

E. Flux:
1. Harris (Product: Stay Clean Paste Flux, Stay Clean Liquid Flux (used with 4 inches or larger copper tubing also stainless steels), or Bridgit Water Soluble Paste Flux).
2. Canfield (Product: Aqua-Brite or AB Cream Flux). Glycerin-based, water soluble.

2.7 REFRIGERANTS AND LUBRICANTS

A. Refrigerant: ASHRAE 34; low global warming potential of 700 or less. Subject to compliance with requirements, refrigerants that may be incorporated into the Work include, but are not limited to the following:
1. R-32: Difluoromethane. Component of blends.
2. R-1234yfr: Tetrafluoropropene. Component of blends.
3. R-125: Pentafluoroethane. Component of blends.
4. R-452b: Blend of R-32/125/1234yf.
5. R-454a: Blend of R-32/1234yf.

B. Oils and Other Lubricants: Provide as required by the refrigerant manufacturer and the equipment manufacturer(s).

2.8 MOISTURE AND LIQUID INDICATORS

A. Manufacturers:
1. Sporlan Valve Co, Model “See-All”.
2. Emerson Climate Technologies.
3. Henry Technologies.
4. Mueller.

B. Indicators: Double port type, UL listed, with steel body, flared or copper plated solder ends, leak proof fused sight glass, replaceable color coded paper moisture indicator and plastic cap; for maximum working pressure of 500 psig for connection sizes 1-1/8 inch O.D. and smaller, 430 psig for sizes 1-3/8 inch O.D. and larger, and maximum temperature of 200 degrees F. Synthetic gaskets are not allowed.

2.9 VALVES

A. Diaphragm Packless Valves:
1. Manufacturers:
a. Henry Technologies.
b. Mueller.
c. Superior.
2. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psig and maximum temperature of 275 degrees F.

B. Packed Angle Valves:
1. Manufacturers:
a. Henry Technologies.
b. Mueller.
c. Superior.
2. Forged brass (or brass and copper), forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psig and maximum temperature of 275 degrees F.

C. Ball Valves:
1. Manufacturers:
a. Henry Technologies.
b. Mueller.
c. Superior.
2. Two piece forged brass body with PTFE ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psig and maximum temperature of 325 degrees F.

D. Service Valves:
1. Manufacturers:
a. Henry Technologies.
b. Mueller.
c. Superior.
2. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psig.

2.10 FILTER-DRIERS

A. Permanent Straight Through Type:
1. Manufacturers:
a. Sporlan, Model CW Catch-All.
b. Emerson Climate Technologies.
2. ARI 710, UL listed, steel shell with copper plated steel sweat or flare fittings, molded molecular sieve/activated alumina desiccant filter core, for maximum working pressure of 500 psig.
3. Rating: ARI 730 flow capacity of the equipment served.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

B. Comply with Federal, State, and local Codes and regulations regarding the handling and disposal of refrigerants and oil. Provide documentation of quantities installed in the system. Document handling and disposal; see “Project Closeout” in this Section.

C. Install refrigeration specialties in accordance with manufacturer's instructions.

D. Flood piping system with nitrogen when brazing.

E. Route piping in orderly manner, parallel or perpendicular to building structure, and maintain gradient.

F. Install annealed piping free of kinks, and with bends only as necessary.

G. Install piping to conserve building space and not interfere with use of space.

H. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

J. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required.

K. Pipe Sleeves and Escutcheons:
1. See Division 23 Section “Sleeves and Escutcheons for HVAC Piping.”
2. Provide sleeves, sized to fit outside the pipe insulation with at least 1/4 inchclearance, at penetrations of building assemblies. Interrupt insulation where required by fire ratings.
3. Extend floor sleeves to 2 inches above finished floor and seal watertight.
4. For below-grade penetrations and where indicated, provide watertight link-type pipe seals.
5. Secure sleeves in place, and caulk, grout or firestop into the building assembly.
6. Provide split chrome or painted escutcheons where exposed to occupancy.

L. Provide clearance for installation of insulation and access to valves and fittings.

M. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Division 08 Section “Access Doors and Frames” or Division 23 Section “Common Work Results for HVAC.”

N. Insulate piping and equipment; refer to Division 23 Sections “HVAC Piping Insulation” and “HVAC Equipment Insulation”

O. Fully charge completed system with refrigerant after testing.

3.3 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Division 01 Section “Quality Requirements.”

B. Test refrigeration system in accordance with ASME B31.5.

C. Pressure test system with dry nitrogen to 200 psig. Perform final tests at 27 inches of mercury vacuum and 200 psig pressure using electronic leak detector. Test to no leakage.

D. Evacuate the system as required by Codes and by equipment manufacturer, including a vacuum test at 0.02 inches of mercury. The system shall be valved off and tested for 2 hours with a pressure rise of no more than 0.002 inches of mercury.

3.4 SYSTEM STARTUP

A. Lubricate motors and other moving parts as necessary before operating them.

B. Charge the system with liquid refrigerant into the low pressure side of the system, where the liquid will evaporate. Expel air from the system. Operate the compressor, condenser, water cooling pumps and evaporator fans during charging. Monitor compressor discharge pressure. Monitor oil levels for a period of 24 hours.

C. Coordinate control setpoints and wiring prior to startup.

D. Change suction filter elements if the pressure drop exceeds 1 Psi after the initial 24 hours of operation. Change suction wax removal cores to filter elements after system cleanup.

E. Adjust expansion valve superheat using a thermistor or thermocouple temperature sensor at the bulb location and a pressure gauge at the external equalizer line (or the compressor). Adjust under full system load, and again when the system stabilizes.

F. Check the system again after seven full days of operation.

G. Periodically clean strainers until no more accumulation occurs.

3.5 PROJECT CLOSEOUT

A. Indicate exact locations of buried piping conduits on As-Built Drawings.

B. Submit records of handling and disposal of refrigerant and oil to verify compliance with Federal, State, and local Codes and regulations.

C. Submit records of installed quantities of refrigerants and oils in each system. Submit manufacturer's product sheets, MSDS, and instructions in the Operation and Maintenance Manuals.

END OF SECTION 232300

SECTION 232500 – HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cleaning of piping systems.

B. Chemical treatment.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Division 01 Section “Summary”: Owner-furnished treatment equipment and chemicals.

1.3 RELATED SECTIONS

A. Division 23 Section “Instrumentation and Control for Mechanical Systems.”

B. Division 26 “Electrical”: Electrical characteristics and wiring connections.

1.4 REFERENCES

A. NFPA 70 - National Electrical Code.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

C. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

D. Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section

with minimum 3 years' experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

B. Installer: Company specializing in performing the work of this Section with minimum 3 years' experience and approved by manufacturer.

1.8 REGULATORY REQUIREMENTS

A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for discharge to public sewage systems.

B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.9 MAINTENANCE SERVICE

A. Furnish service and maintenance of treatment systems for 1-year from Date of Substantial Completion.

B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit 2 copies of field service report after each visit.

C. Provide laboratory and technical assistance services during this maintenance period.

D. Include 2-hour training course for Owner's operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Schedule the course at Owner's convenience after start-up of systems.

E. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

1.10 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of Division 01 Section "Product Requirements."

B. Provide sufficient chemicals for treatment and testing during warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Chemical Treatment Systems Products, and Services:
   1. Barclay Water Management, Inc., Watertown, MA office.
   2. Nalco Company, Windham, ME office.

B. Chemical Treatment Products:
1. Nu-Calgon.
2. Culligan.
3. H-O-H Water Technology, Inc.
4. Wesco Chemicals, Inc.

2.2 MATERIALS

A. System Cleaner:
1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products].
2. Biocide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

B. Closed System Treatment (Water):
1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
2. Corrosion inhibitors; liquid boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
3. Conductivity enhancers; phosphates or phosphonates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

A. Concentration:
1. As recommended by manufacturer.
2. 1 pound per 100 gallons of water contained in the system.
3. 1 pound per 100 gallons of water for hot systems.

B. Hot Water Heating Systems:
1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
3. Circulate for 6 hours at design temperatures, then drain.
4. Refill with clean water and repeat until system cleaner is removed.

C. Use neutralizer agents on recommendation of system cleaner supplier and approval of

Architect/Engineer.

D. Flush open systems and glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

END OF SECTION 232500

SECTION 233013 – HVAC AIR DUCT CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Air duct cleaning to include site preparation, source removal of dirt and debris, chemical surface treatment, duct openings, sealing and repair of duct insulation.

B. At the time of Substantial Completion, the entire air distribution system shall be turned over to the Owner clear of construction dust and debris. If the interior surfaces of any ducted air moving equipment or the interior surfaces of any portion of the ductwork distribution system are found, as determined by the Architect, to contain significant construction dust and debris, the entire ductwork distribution system shall be cleaned in accordance with this Specification Section. If proper precautions are taken to prevent construction dust and debris from entering the ductwork during construction, and if the Architect finds the ductwork to be free from such dust and debris, air duct cleaning shall not be required.

1.2 QUALITY ASSURANCE

A. The publications listed below form a part of this specification to the extent referenced.

B. The publications are referred to in the text by the basic designation only.

C. NADCA Standard 1992-01, Mechanical Cleaning of Non-Porous Air Conveyance System Components.

D. SMACNA Standards, HVAC Duct Construction Standards - Metal and Flexible (HVACDCS).

1.3 AIR DUCT CLEANING CONTRACTOR

A. Obtain the services of a qualified HVAC system cleaning Subcontractor to perform the air system cleaning as specified herein. Prior to commencing work under this section of the specifications, the testing organization shall have been approved by the Engineer. The criteria for determining qualifications shall be recent experience with similar projects done in accordance with National Air Duct Cleaners Association (NADCA) Standard 1992-01.

1.4 SUBMITTALS

A. Submit experience list of similar projects.

B. Submit cleaning methodologies and material safety data sheets (MSDS) for chemicals to be used.

PART 2 - PRODUCTS

2.1 APPROVED DUCT CLEANING AGENCIES

A. Mechanical Services, Inc., Portland, ME - Tel # 800-675-0229

B. Air Duct Klean, a division of Kitchen Klean, Inc., Epsom, NH - Tel # 800-736-4484

C. Cochrane Ventilation, Inc., Wilmington, MA - Tel # 800-974-9055

D. Haley's Metal Shop, Inc., Biddeford, ME - Tel # 207-284-8571

E. Portland Diversified Services, Westbrook, ME - Tel # 800-639-3901

F. Steamatic, Portland, ME - Tel # 207-657-3088

2.2 PROCEDURES FOR AIR DUCT CLEANING

A. Perform work in accordance with NADCA Standard 1992-01.

B. Supply materials for cleaning, repairing and inspection work including HEPA filtered collection systems, rotary brushes, air lances, mechanical agitators, fiber optic borescopes, vacuums, or other equipment and materials necessary to perform work specified. Furnish materials and equipment that are of a reputable manufacturer. Submit Material Safety Data Sheets for chemicals utilized in this project prior to product usage.

C. Access points shall be constructed of metal or plastic. Points shall be installed in a hole that is a minimum of 1 inch in diameter. Access points shall be reusable by Owner's maintenance staff. If external insulation is removed during the installation process, repair the open edges with a similar color repair tape (to the best extent possible).

D. Access doors shall consist of 3 layers of precision stamped 0.030-inch (23 gauge) (0.78 mm) electro-galvanized zinc-plated steel. The inside door shall consist of 2 layers of metal which are spot-welded together at the rim, encapsulating high density fiberglass insulation - UL classified FHC 25/50. The inside surface shall be smooth to reduce friction. The gasket which seals the door from the inside to the duct shall consist of a closed cell neoprene gasket which is UL 94HF 1 listed with a service temperature of (ASTM D746) 70 to 220 degrees F (21 to 104 degrees C). The gasket shall be permanently bonded to the inside of the door to eliminate leakage. Conical springs shall be installed over the bolts, between the inner and outer door, to facilitate opening. Access shall be accomplished by use of high impact polypropylene molded knobs that have threaded brass inserts to eliminate thread stripping. Knobs shall be easy to turn by hand without wrenches. Door shall be tested to 20 in. WG (4.9 kPa) with no leakage noted. The installed access door shall be a permanent reusable access system that can be utilized for further inspections and/or repair.

E. Clean outdoor air plenums thoroughly. Vacuum or scrape inlet louvers, bird screens, dampers, turning vanes, moisture deflectors and other irregular surfaces, if necessary.

F. Vacuum the interior surfaces of the mixing chamber, removing gross debris. Sanitize the

plenum, drains, and dampers with an EPA registered sanitizing agent.

G. Remove filters from the rack and prepare the area for cleaning. If filters are to be reused, clean and store in a dry area. Scrape debris from the filter rack area. Vacuum clean and/or pressure wash the filter rack system (ensure proper drainage is available before cleaning). Sanitize the filter rack system.

H. Remove standing water from the condensate pans or base of the plenum. Clear the drains associated with each pan, ensuring proper operation before cleaning. If fins are bent prior to cleaning, straighten fins utilizing a coil combing system after the cleaning process. High-pressure-water clean the coil section. First apply a biodegradable cleaning solution to penetrate into the coil section (follow manufacturer's guidelines). Repeat process on the other side of the coil section. Rinse each side. Continue process until clear water can penetrate coil section on entire coil face. After cleaning, sanitize coil section with an approved biocide-utilizing atomizing system. Report existing damage to the coil section or improper drainage in writing to the Architect.

I. Vacuum clean the fan housing and motors to remove debris. Hand scrape fan impellers and remove loose debris from the internal surfaces of the fan housing. Take precautions not to damage the impellers, alter blade shape or weight, or affect impeller balance.

J. Vacuum the internal surfaces of the plenums associated with the air handler. Remove gross debris and other debris or excess equipment that may be present. In severe cases, the internal plenum surface may be high-pressure-water cleaned to remove grease, dirt, and debris. After interior surfaces and equipment are cleaned, sanitize the unit with an approved sanitizer utilizing an atomizing system.

PART 3 - EXECUTION

3.1 DUCTWORK CLEANING PROCESS

A. Equipment used shall be portable and sized to enter these areas. Coordinate electrical requirements through the Owner's electrical or maintenance department, as appropriate. Modifications to accommodate electrical requirements will be at the Contractor's expense.

B. Address each main duct section by first securing debris collection equipment to diffuser branch ducts or to an isolated section of main trunk ductwork.

C. Collectors shall be fan powered, high velocity dust and particle collection systems which will be utilized in areas where debris is being removed from the system. Equip collection systems with HEPA filtration (99.97 percent collection efficiency for 0.3 micron size). The collection systems shall be self-contained, with appropriate components to adequately prevent dirt and debris loosened from upstream duct mains and branches during cleaning operations from entering the diffuser plenums by capturing this debris within the collection device. The components of the collector that connect the base collection unit to the duct or diffuser plenum shall be air-tight and reusable from area to area.

D. Agitate the loose debris on the interior surfaces to introduce the debris into the air flow

produced and controlled by the collection systems. Collection systems shall be able to produce a minimum of 0.42 in.WG (104 Pa) in the targeted section of duct to be cleaned. Debris shall travel through the ductwork to the point of collection.

E. Ductwork shall be cleaned by inserting air powered brush systems, air powered extended whip sections, electric rotary brush systems, skipper balls, or air sweeps through the installed access. Utilize equipment that will best contact surfaces of the duct regardless of shape or size.

F. Where duct is large enough and able to support the weight of a worker, hand tools and vacuums may be used. Install collection equipment in the section of duct to be cleaned by hand as a precautionary measure to catch any residual debris.

G. Whenever the grilles, registers, or diffusers are removable, they shall be removed, washed, rinsed, dried, and then replaced. If for any reason they are not removable, they shall be vacuumed in place.

H. Perform sanitizing of the air distribution system as required using an air sprayer or fogging device to cover the interior surfaces of the ductwork. Make certain that surfaces are kept wet for at least 10 minutes. Sanitizing fluid shall be registered with the Environmental Protection Agency. Sanitizing shall be accomplished through installed access doors and access points.

I. Perform duct cleaning and sanitizing only at a time when the targeted air distribution systems can be shut down and the facility cleared of occupants. Schedule the duct cleaning for an appropriate time. Note: Occupants does not include maintenance or supervisory personnel who take proper precautions.

J. Replace, at no additional cost to the Owner, any ceiling tiles or gridwork that is/are damaged during the ductwork cleaning process.

3.2 PROJECT ASSESSMENT

A. Provide inspection access to the Architect any time during or immediately after the cleaning of the air delivery system or systems. Inspection shall be visual in nature by means of installed access doors and points with the benefit of a fiber optic borescope where necessary. Meet the guidelines set down in the NADCA Standard 1992-01 for Mechanical Cleaning of Non-Porous Air Conveyance System components.

B. Perform the NADCA vacuum test and submit report for approval.

C. Show exact locations of access doors installed as part of the cleaning process on the Record Drawings.

END OF SECTION 233013

SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal Ductwork.

B. Nonmetal Ductwork.

C. Casing and Plenums.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Division 23: Sensors and airflow measuring stations furnished under Division 23 Section "Instrumentation and Control for Mechanical Systems"; gauges and meters.

B. Division 26 – Electrical: Smoke detectors.

1.3 RELATED SECTIONS

A. Division 01 Section "Testing, Adjusting and Balancing for HVAC."

B. Division 03 Section "Cast-in-Place Concrete."

C. Division 09 Section "Painting": Weld priming, weather resistant, paint or coating.

D. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment": Sleeves.

E. Division 23 Section "Duct Insulation": External insulation and duct liner.

F. Division 23 Section "HVAC Air Duct Cleaning."

G. Division 23 Section "Air Duct Accessories"

H. Division 23 Section "Air Outlets and Inlets."

1.4 REFERENCES

A. ASTM A 36 - Structural Steel.

B. ASTM A 90 - Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

E. ASTM A 568 - Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

F. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

G. ASTM A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

H. ASTM A 1011 - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

I. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.

J. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

K. AWS D9.1 - Welding of Sheet Metal.

L. NBS PS 15 - Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.

M. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

N. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

O. SMACNA - HVAC Duct Construction Standards - Metal and Flexible (SMACNA HVACDCS).

P. UL 181 - Factory-Made Air Ducts and Connectors.

1.5 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes is permitted except by written permission from the Architect. Size proposed substitutions of round ducts in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.6 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures”.

B. Shop Drawings: Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration. Submit prior to start of work.

C. Product Data: Provide data for duct materials, duct liner and duct connectors.

D. Samples:
1. Submit as indicated on the Drawings, and as specified herein.
2. Submit sample shop-fabricated mitered (vaned) and radiused elbows.
3. Submit mock-up installation of a vertical fire damper.

E. Test Reports: Submit testing apparatus, procedures, and preliminary forms prior to performing tests. On final reports, indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Indicate additional fittings used.

1.8 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA HVACDCS.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Installer: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.10 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 standards.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealants.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Flexible Ducts:
1. Atco Rubber Products, Inc. – 30 Series (insulated).
2. Flexible Technologies Group - Thermaflex product line.
3. Flexmaster U.S.A. – Type 6 product line.
4. Hart and Cooley – F246 Commercial Series.
5. Buckley Associates - Flexmaster Triple-Lock Buck Duct product line.
6. No substitutions.

B. Plastic Drawbands:
1. Panduit.

2. Thomas and Betts.
3. Tyton.

C. Tape for Flexible Ducts:
1. Ideal Tape Co., division of American Biltrite Inc.
2. 3M Company.
3. Nashua Tape Products, division of Berry Plastics Corp.
4. Venture Tape Corporation.
5. No substitutions.

D. Manufactured Ductwork - Round and Flat Oval:
1. McGill AirFlow LLC, a subsidiary of United McGill Corporation.
2. Aero Heating & Ventilating, Inc.; Portland, ME.
3. Air Purchases, Inc.; Manchester, NH – spiral duct lengths.
4. Atlantic Air Products LLC; Bow, NH.
5. Central City Sheet Metal; Brewer, Caribou, and Gorham, ME.
6. Hahnel Brothers; Bangor and Lewiston, ME.
7. Hranec Corporation; Uniontown, PA.
8. Lindab, Inc. – duct fittings only.
9. Macy Industries, Inc.; Hookset, NH.
10. Monroe Metal Mfg. Inc.; Monroe, NC.
11. Northeastern Sheet Metal Inc.; Goffstown, NH.
12. Semco Inc., division of the Flakt Woods Group.
13. S.G. Torrice Co.; Wilmington, MA – spiral duct lengths.
14. Sheet Metal Connectors Inc.; Minneapolis, MN.
15. Spiral Manufacturing Co. Inc.; Minneapolis, MN.
16. Total Air Supply; Nashua, NH – spiral duct lengths.
17. No substitutions.

E. Manufactured Ductwork - Transverse Duct Connection System:
1. Ductmate.
2. HFC Enterprises; Baldwin Park, CA – Dura Flange product line, for round and flat oval ducts only.

F. Sealants:
1. Hardcast, a division of Carlisle Corporation.
2. 3M Company.
3. Ductmate.
4. Foster.
5. McGill AirSeal LLC, a subsidiary of United McGill Corporation.
6. Mon-Eco Industries, Inc - Eco product line.
7. Polymer Adhesive Sealant Systems.

2.2 MATERIALS

A. Galvanized Steel Ducts:
1. Steel sheet metal components of galvanized ductwork in this Specification Section shall be galvanized steel sheet, lock-forming quality, having G60 or heavier zinc coating (G90 minimum for outdoor or moist applications) conforming to ASTM A653 rating system

and tested in accordance with ASTM A90.
2. Provide paint-grip exterior surfaces for exposed ducts, where available.
3. Sheet metal gauge shall be not less than 26 gauge.

B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.

C. Stainless Steel Ducts: ASTM A167, Type 304 or 316. Material for exposed ducts shall have a finish at least equal to Mill Polished No. 4.

2.3 FLEXIBLE DUCTS

A. Insulated Flexible Ducts:
1. Semi-Rigid Flexible Aluminum Ductwork:
   a. Flexmaster Triple-Lock Buck Duct - Insulated.
   b. Triple lock mechanical joint aluminum flex duct, constructed entirely without the use of adhesive.
   c. Fiberglass insulation and fire-retardant polyethylene vapor retarder film.
   d. Pressure Rating: Positive pressure 12 in. WG for all sizes. Negative pressure 12 in. WG for sizes thru 16 in. diameter, 8 in. WG for sizes 18 and 20 in. diameter.
   e. Maximum Velocity: 5500 fpm.
   f. Inside bend radius: Minimum one diameter.
   g. Temperature Range: -40 to 250 degrees F.
   h. UL 181, Class 0 air duct.
   i. Meets NFPA 90A and 90B standards.
2. Fabric-Core Flexible Ductwork:
   a. Thermaflex Model M-KC.
   b. Greenguard certified.
   c. UL 181, Class 1, heavy fiberglass cloth fabric supported by helically wound spring steel wire; fiberglass insulation; reinforced metalized vapor barrier film.
   d. Pressure Rating: 10 inches WG positive and 2.0 inches WG negative.
   e. Maximum Velocity: 6000 fpm.
   f. Temperature Range: -20 to 250 degrees F.

B. Non-Insulated Flexible Ducts:
1. Semi-Rigid Flexible Aluminum Ductwork:
   a. Flexmaster Triple-Lock Buck Duct - Bare.
   b. Triple lock mechanical joint aluminum flex duct, constructed entirely without the use of adhesive.
   c. Pressure Rating: 12 inches WG (2988 Pa) positive for all sizes, 12 inches WG negative for sizes thru 16 in. diameter, 8 inches WG negative for sizes 18 in. and 20 in. diameter.
   d. Maximum Velocity: 5500 fpm.
   e. Inside bend radius: Minimum one diameter.
   f. Temperature Range: -40 to 250 degrees F.
   g. UL 181, Class 0 air duct.
   h. Meets NFPA 90A and 90B standards.

C. Return and Exhaust: Use either semi-rigid flexible aluminum type (insulated or bare), or fabric-

core type (insulated). Non-insulated fabric-core type does not have adequate negative pressure rating.

2.4 ACCESSORIES

A. Drawbands for Flexible Ducts:
1. Stainless Steel: 1/2 inch wide with screw-driven worm gear.
2. Plastic: Panduit PLT5H or PLT8H; Thomas and Betts Dukt-Rap, VAL-26-50, or VAL-275X-25; or Tyton T150L or LX. Install with manufacturer's lever-action tightening tool.

B. Tape for Flexible Ducts: Ideal-Seal 587A/B, UL 181B-FX listed, aluminum foil with pressure-sensitive acrylic adhesive, -20 to 250 degrees F temperature range, 25.0 lb/in. width tensile strength.

C. Fasteners: Rivets, bolts, or sheet metal screws.

D. Sealants: See Duct Sealant portion of this Specification.

E. Hanger Rod: ASTM A36; galvanized steel; threaded both ends, threaded one end, or continuously threaded.

2.5 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVACDCS, as specified or as indicated on the drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. SMACNA Duct Construction Manuals:
1. The SMACNA recommendations shall be considered as mandatory requirements.
2. Substitute the word "shall" for the word "should" in these manuals.
3. Where the Contract Specifications differ from SMACNA recommendations, the more stringent requirements (as determined by the Architect) shall take precedence.
4. Details on the Contract Drawings take precedence over SMACNA standards.

C. Sheet metal shall be galvanized steel as specified in Part 2 paragraph "Materials" in this Section, unless otherwise indicated or specified.

D. Construct Tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline.
1. Where space is too restricted for full-radius elbows, provide mitered (square-throat) elbows with single wall turning vanes. Do not use air foil turning vanes.
2. Mitered elbows in round or flat-oval ductwork shall be factory-manufactured.
3. Radiused elbows with throat radius 1/2 times width of duct (centerline radius 1 width of duct) may be used instead of mitered elbows, but only where space is too restricted for full radius.
4. Fittings not conforming to these requirements will be ordered removed and replaced with proper fittings.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence or convergence (per side) wherever possible; maximum 30 degrees divergence (per side) upstream of equipment and 45 degrees convergence (per side) downstream.

F. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.

G. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

H. Longitudinal locks or seams known as “button-punch-snap-lock” and other “snap-lock” types will not be permitted in rectangular duct. Snap-lock longitudinal seams may be used on round ducts up to 8 inches diameter, with screws provided to secure the seams at 24 inches on center maximum spacing.

I. Exposed Ducts: Select and handle materials with care for a neat appearance. Joint connections on round and flat oval ducts shall be sleeve or flanged type; drawbands are not acceptable.

2.6 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufactured ductwork and fittings listed below are acceptable alternatives to standard ductwork systems. For exposed round and flat oval ductwork, factory-manufactured ductwork and fittings are required.

B. Manufacture in accordance with SMACNA HVACDCS, and as specified or as indicated on the drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

C. Exposed Round and Flat Oval Ductwork: Shall be manufactured ductwork by one of the listed manufacturers.
   1. Spiral Ductwork Acceptable Products:
      a. McGill Airflow: Standard Uni-Seal product line (smooth surface between spiral lockseams) or Uni-Rib product line (one standing seam reinforcement between each pair of spiral lockseams).
      b. Monroe Metal Inc.: Standard spiral product line (smooth surface between spiral lockseams). V-Rib product line is not allowed.
      c. Other Manufacturers: Standard spiral product line (smooth surface between spiral lockseams).
      d. Ductwork and fittings shall be products of a single manufacturer.

D. Exposed Ducts:
   1. Select and handle materials with care for a neat appearance.
   2. Joint connections on round and flat oval ducts shall be sleeve or flanged type; drawbands are not acceptable. Joint connections on flat oval ducts 42 inches and wider shall be flanged type to ensure tight fit and good appearance.
   3. Provide exterior reinforcing only where required, with prior approval from the Architect.
   4. External reinforcement of flat-oval ducts shall be full-perimeter angle rings. Straight angles along flat sides only are not allowed.

E. Galvanized and stainless steel sheet metal used in fabrication shall be not less than 26 gauge thickness. Aluminum shall be not less than 0.025 in. nominal thickness. This requirement supersedes SMACNA requirements.

F. Round and Flat Oval Duct and Fittings:
1. Shall be suitable for at least 4 in. WG positive pressure and 2 in. WG negative pressure in accordance with SMACNA HVACDCS standards. This is a minimum; provide higher ratings where required.
2. Fittings shall be fabricated of sheet metal at least one gauge heavier than straight duct of the same size.
3. Fittings shall be factory-sealed so that no field sealing of joints between gores or segments is required. Acceptable methods of construction are fully welded, spot-welded with inner sealant, or standing-seam crimped joints.

G. Radiused Elbows in Round and Flat Oval:
1. In exposed ductwork shall be non-adjustable type, factory-sealed.
2. In concealed ductwork may be adjustable type, with full long radius as detailed on the Drawings. Short-radius elbows are not allowed.
3. Shall be constructed of the following minimum number of segments or gores: 90-degree: 4 gores; 60-degree: 3 gores; 45-degree: 3 gores; 30-degree: 2 gores; 22-1/2-degree: 2 gores.
4. 1-piece stamped elbows are acceptable up to 12 inches diameter. Pleated elbows are acceptable up to 10 inches diameter.

H. Mitered Elbows in Round and Flat Oval:
1. Available in both 90-degree and 45-degree elbows.
2. Shall have minimum number of welded single-wall vanes as follows (size is duct width in plane of bend):
   a. 3 to 9 inch: 2.
   b. 10 to 14 inch: 3.
   c. 15 to 19 inch: 4.
   d. 20 to 60 inch: 5.
   e. Larger Sizes: 12-inch maximum spacing.

I. Inner tie-rod reinforcement is not allowed. Increase duct sheet metal gauge or external reinforcement as required.

J. Flat Oval Ducts: Machine made from round spiral lockseam duct.

K. Transverse Duct Connection System: SMACNA "F" rated or SMACNA "J" rated rigidity class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips. Product shall be Ductmate factory-manufactured connectors, or field-formed flanges using a specialized machine.

2.7 PRESSURE CLASSIFICATION

A. Ratings as indicated on the Drawings or as specified. See Ductwork Pressure Class Schedule in Part 3 of this Section.

B. If no ratings are indicated, ductwork shall be rated for the external static pressure of the system plus 25 percent.
   1. If 4 dampers (of any type) or fewer can isolate a duct system, that portion of the system shall be rated for the shut-off pressure of the system fans.

2.8 DUCT SEALING

A. Seal ductwork as outlined in the SMACNA HVACDCS. Seal ductwork to a minimum of class A (transverse joints, longitudinal seams, and duct wall penetrations), regardless of pressure class.

B. Seal ductwork systems as required to ensure that maximum duct leakage does not exceed that allowed by the latest edition of the SMACNA HVAC Air Duct Leakage Test Manual. Allow sealant to dry in accordance with manufacturer's requirements of time and environmental conditions before ductwork systems are pressurized.

C. Duct sealing materials used shall be non-flammable and non-combustible in both liquid and solid states.

D. Seal Pittsburgh hammered lockseams by flooding the joint with sealant prior to assembly.

E. Seal exposed ducts by applying mastic-type or gasket-type sealer just before the joint or seam is made; remove excess sealant for a neat appearance.

F. Fill (with matching duct material such as sheet metal) any gaps in duct which exceed the recommendations of the sealant manufacturer, and in no case shall liquid or mastic sealant be used to fill gaps or openings which exceed 1/8 inch in any direction. Verify that system air pressure acting on a wide gap will not exert enough force to damage or loosen the sealant.

G. Materials for Sealing:
   1. Hardcast: Flex-Grip 550 or Iron-Grip 601 mastic.
   2. Hardcast: gypsum-based tape and mastic, waterproof type when used on moist-air exhaust or in humid or outdoor locations.
   3. Ductmate: Flanged lateral joints with gaskets.
   4. Ductmate: PROseal.
   5. Foster: Duct-Fas or Safetee mastic sealant. Duct-Fas is UV resistant and recommended for applications exposed to sunlight.
   6. Mon-Eco: Eco-Duct Seal 4450 (red color) or 4452 (grey color). Use grey color where ducts will be unpainted and exposed to public view.
   7. Polymer Adhesives Sealant Systems: Airseal No. 11 premium sealant.

2.9 UNIFORMITY OF MATERIALS

A. Ductwork accessories, including but not limited to volume dampers, smoke dampers, fire dampers, combination fire/smoke dampers, backdraft dampers and motorized dampers, shall be fabricated of materials that are similar to the ductwork in which they are installed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components furnished under other Section and Divisions of the Specifications. Such items may include but are not limited to: Sensors and airflow measuring stations furnished under Division 23 Section “Instrumentation and Control for Mechanical Systems”; gauges and meters; and smoke detectors furnished under Division 26 – Electrical.

C. Install ducts in accordance with SMACNA HVACDCS.

D. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

E. “Fishmouth” duct connections are not allowed.

F. Inner tie-rod reinforcement is not allowed. Increase duct sheet metal gauge or external reinforcement as required.

G. Outdoor Ducts Serving Energy Recovery Ventilators: Acoustically line in accordance with Section 230713 “Duct Insulation.”

H. Exposed Ducts:
1. Handle with care for a neat appearance. Repair or replace dented or damaged ductwork as required by the Architect. Select hangers for appearance, and to prevent sagging or distortion of duct.
2. Remove labels attached to ducts before receiving paint.

I. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

J. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

K. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

L. Use double nuts and lock washers on threaded rod supports. Strap hangers shall be minimum 16 gauge x 1 inch galvanized straps. Hanger and support components including but not limited to “unistrut” shall be galvanized steel except that where other duct materials are used, the hanger materials shall be compatible and non-corrosive to the duct. Wire hangers are not acceptable.

M. Flexible Ducts:
1. Connect diffusers or light troffer boots to low pressure supply ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

2. Minimum bend radius shall be one and one half times the duct diameter. Support the bend to maintain this radius.
3. Bends shall not exceed 45 degrees.
4. Connect flexible ducts to metal ducts with 2 turns of duct tape and metal draw bands. Plastic drawbands may be used if they are installed using the band manufacturer's lever-action tightening tool. On insulated flexible ducts, provide an additional seal of tape and drawband on the insulation's vapor barrier.

N. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Do not start ducted air moving equipment until construction is completed to a stage where airborne construction dust is no longer present. At the time of substantial completion, the entire air distribution system shall be turned over to the Owner clear of construction dust and debris. If the interior surfaces of any ducted air moving equipment or the interior surfaces of any portion of the ductwork distribution system are found, as determined by the Architect, to contain significant construction dust and debris, the entire air distribution system shall be cleaned in accordance with Division 23. If proper precautions are taken to prevent construction dust and debris from entering the ductwork during construction and if the Architect finds all ductwork to be free from such dust and debris, air duct cleaning shall not be required.

O. For fresh air intake and exhaust plenums connected to louvers or brick or block vents, pitch bottom of plenums down to bottom of louver at minimum 1/4 inch per foot (2 percent). Seal connections and joints on bottom of plenums watertight with mastic. Connect bottom of plenum to top-inside edge of bottom louver blade or waterstop as detailed on the Drawings, to ensure positive drainage

P. Install duct-mounted components furnished under other Sections of this Specification, such as smoke dampers, control dampers, control sensors, and smoke detectors. Install with straight lengths of duct as required for proper operation. Provide access at such components as required. Install in accessible locations for maintenance; notify the Architect if a location indicated or selected requires addition of access by other trades.

3.2 SCHEDULES

A. Ductwork Material Schedule

AIR SYSTEM	MATERIAL
Low Pressure Supply (Heating Systems)	Galvanized Steel, Aluminum
Low Pressure Supply (System with Cooling Coils)	Galvanized Steel, Aluminum
Return and Relief	Galvanized Steel, Aluminum
General Exhaust	Galvanized Steel, Aluminum
Outside Air Intake	Galvanized Steel, Aluminum

B. Ductwork Pressure Class Schedule

AIR SYSTEM	SMACNA PRESSURE CLASS
Supply (Heating Systems)	2 inch
Supply (System with Cooling Coils)	2 inch
Return and Relief	2 inch
General Exhaust	2 inch
Outside Air Intake	2 inch

END OF SECTION 233113

SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Dampers:
   1. Backdraft Dampers.
   2. Counterbalanced Dampers.
   3. Fire Dampers.
   4. Volume Control Dampers.

B. Drip Pans for Humidifiers.

C. Duct Access Doors.

D. Duct Sleeves, Prepared Openings and Closure Collars.

E. Duct Test Holes.

F. Flexible Duct Connections.

G. Round Duct Branch Taps.

H. Turning Vanes.

I. Wire Mesh for Screens.

1.2 RELATED SECTIONS

A. Division 01 Section “Operation and Maintenance Data.”

B. Division 07 Section “Through-Penetration Firestop Systems.”

C. Division 23 Section “Identification for HVAC Piping and Equipment.”

D. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

E. Division 23 Section “Instrumentation and Control for Mechanical Systems.”

F. Division 23 Section “Metal Ducts.”

G. Division 23 Section “Steam Humidifiers.”

H. Division 26 “Electrical”: Electrical characteristics and wiring connections.

1.3 REFERENCES

A. ASTM C423-02a - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

B. ASTM E477-99 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

D. NFPA 70 - National Electrical Code.

E. SMACNA - HVAC Duct Construction Standards - Metal and Flexible, Third Edition - 2005 (HVACDCS).

F. SMACNA - Seismic Restraint Manual - Guidelines for Mechanical Systems (SRMGMS).

G. UL 94 - Safety of Flammability of Plastic Materials for Parts in Devices and Appliances Testing.

H. UL 1995 - Heating and Cooling Systems.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.

C. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

B. Record actual locations of access doors and test holes.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories

Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section "Product Requirements."

B. Protect dampers from damage to operating linkages and blades.

PART 2 - PRODUCTS

2.1 GALVANIZED STEEL

A. Steel sheet metal components of accessories in this Specification Section shall be galvanized steel sheet, lock-forming quality, having G60 or heavier zinc coating conforming to ASTM A653 rating system and tested in accordance with ASTM A90. Provide paint-grip exterior surfaces for exposed ducts, where available.

2.2 DAMPERS

A. Manufacturers:
1. Ruskin.
2. Air Balance, Inc.
3. Arrow.
4. Cesco.
5. Greenheck.
6. NCA.
7. Tamco.
8. Ventex.
9. Vent Products, Inc.
10. No substitutions.

B. Backdraft Dampers:
1. Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
2. Multi-Blade, Parallel Action Gravity Backdraft Dampers: Frames of 16 ga thick galvanized steel, or extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball or sintered bronze bearings, and plated steel pivot pin. Pressure and velocity ratings shall be suitable for the application.

C. Counterbalanced Dampers:
1. Multi-Blade, Parallel Action Gravity Balanced Counterbalanced Dampers: Frames of 16 ga (1.5 mm) thick galvanized steel, or extruded aluminum, with blades of maximum 6 inch (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball or sintered bronze bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure. Pressure and velocity ratings shall be suitable for the application.

D. Fire Dampers:
1. Fabricate in accordance with NFPA 90A and UL 555, and as specified or as indicated on the Drawings.
2. Fire Dampers Other Than Ceiling Dampers: Dynamic-closure type.
   a) Fire dampers shall be of the dynamic closure type, shall have been successfully tested to UL Standard 555 - 6th Edition as to their ability to close under dynamic airflow conditions and shall bear the UL label stating that they are suitable for that application. Static fire dampers designed to operate with no airflow in the ductwork shall not be acceptable. Dynamic closure fire dampers shall have been successfully tested in both horizontal and vertical mounting positions to close against a velocity of 2,400 fpm and a static pressure of 4.5 in. w.g.
   b) Multiple Blade Dampers: Galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, plated steel concealed linkage, stainless steel closure spring, and blade stops. Dampers shall be dual-directional airflow rated for ease of installation.
      1) Dampers shall be equal to Ruskin DFD60, airfoil-shaped blades, rated for 4,000 fpm and 4 in. w.g. maximum, 1-1/2-hour or 3-hour rated as required. Pressure drop at 1,000 fpm in a 24 in. x 24 in. damper shall not exceed 0.03 in. w.g. Damper linkage shall be capable of being held open with a pair of hand pliers while the fusible link is replaced during testing.
      2) Curtain-Type Dampers: For use in easy-access locations directly behind grilles and registers or open-ended ducts ONLY. Type B with blades out of the air stream. Provide thinline type where required. Galvanized steel with interlocking blades. Stainless steel closure springs.
   c) Submittals shall include a schedule of damper locations indicating size, design airflow, design airflow face velocity, system external static pressure, and fire rating of the building assembly, with selected damper model, accompanied by damper and accessory data sheets and manufacturer's installation instructions. If only one model of damper is required, submittals may be simplified accordingly.
   d) Dampers may be furnished with factory sleeves (verify length and gage), retaining angles, and breakaway connections at the Contractor's option. Sleeves shall not intrude into occupied space or interfere with other building elements.
   e) Dampers for Out-of-Wall or Out-of-Floor Installation: Provide factory assembly including damper, sleeve, and factory-installed fire-retardant insulation.
3. Ceiling Dampers:
   a) To provide fire and heat protection where HVAC components penetrate the ceiling membrane of fire-rated floor/ceiling or roof/ceiling assemblies, standard 1-1/2 and 3 hour primary fire dampers DO NOT provide the necessary protection. Ceiling dampers are required.
   b) Description: UL Classified radiation dampers, galvanized steel, with butterfly-type blades, UL-classified blade insulation as required.
   c) Provide external thermal insulating blankets as required by damper manufacturer. Provide retainer wire as required.
   d) Associated components (air devices, ductwork, supports) shall be steel. For installation with non-ferrous air devices, provide steel extensions and/or steel angles to the ceiling surface as required by damper manufacturer.

4. Fusible Links: UL 33, separate at 165 degrees F with adjustable link straps for combination fire/balancing dampers. Provide links melting at 212 degrees F within 50 feet downstream of heating coils.
    a) Mounting shall either be the flat-strap type requiring no tools to bend the straps for removing the link, or shall use standard threaded hex-nut fastening. Fastening with heavy-gauge wire hooks or other methods requiring difficult bending are not allowed.
5. Testing and Access: See Part 3 of this Section for requirements for field testing of each damper, and associated access doors. Provide replacement fusible links as required. During testing, furnish means for holding dampers open while fusible link is reset.

E. Volume Control Dampers:
1. Factory-fabricate in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings.
2. Shop fabrication is permitted for single blade dampers only.
3. Height is the dimension perpendicular to the blade rod or shaft. Width is the dimension parallel to the blade rod.
4. Single Blade Dampers: For duct sizes (height x width) up to 7 x 30 inch. When height or width exceeds its respective maximum, provide multi-blade damper.
5. Multi-Blade Damper: Opposed blade pattern with maximum blade sizes (height x width) 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
6. End Bearings: Except in round ductwork 6 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings. Provide retainer clips or other devices to prevent bearings from pulling out. For single-blade dampers, plastic bearings are allowed.
    a) Manufacturers:
        1) Duro Dyne.
        2) Elgen Manufacturing.
        3) Rossi.
        4) Ventfabrics.
    b) Snap-in Plastic Bearings for Single-Blade Dampers: Designed to push into hole in sheet metal, with retaining tabs. Flame Retardant, Glass Reinforced, “Zytel” polymer by Dupont, conforming to UL 1995 and UL 94 with the required flammability rating of 5VA or lower. Acceptable materials include Polyamide 66 (PA66) (glass-reinforced Dupont Zytel), nylon and acetyl. Submit manufacturer’s verification of the suitability of these bearings for the application, including operating pressures and temperatures.
7. Quadrants:
    a) Manufacturers:
        1) Duro-Dyne.
        2) Elgen Manufacturing.
        3) Rossi.
        4) Ventfabrics.
    b) Duro-Dyne Specline SR and SRH series; Quadline series; or Stampline dial regulators and wedge-loc regulators. Or equal by Elgen, Rossi, or Ventfabrics. Rossi Everlock regulators shall be acceptable equivalents to Duro-Dyne. Factory-manufactured dampers shall have damper manufacturer’s choice of quadrant equal to the Duro-Dyne products specified.

c) Provide locking, indicating quadrant regulators on single and multi-blade dampers [and splitter dampers]. Regulators shall include lever handle, locking wing nut and graduated indicator dial. Provide shaft seals, bushings, or gaskets for duct penetrations. Quadrants without these features are not allowed.
   1) Rossi Everlock Regulators: Locking lever handle of Polyamide 66 (PA66) (glass-reinforced Dupont Zytel) plastic, thumb trigger with stainless steel spring, with at least 9 latching positions in a 90 degree rotation.

d) On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters, with open space to run insulation through.

e) Where rod lengths exceed 30 inches provide regulator at both ends, with a single rod so that either regulator will control the entire damper.

8. Remote Manual Operators:
   a) Manufacturers:
      1) Young Regulator Company.
   b) Cable Type with Rack and Pinion: Bowden remote cable assembly, including rack and pinion controllers at damper and ceiling, galvanized angle bracket for duct mounting, stainless pull wire with galvanized steel flexible outer casing, and 2-5/8 in. diameter zinc cup with 3 in. diameter cover plate.
   c) Cable Type with Worm Gear Actuator: Model 1200-FS with worm gear operator for duct mounting, flexible shaft, and concealed ceiling cup and cover.
   d) Rigid Shaft Type with Worm Gear Actuator: 927 or 1200 series worm gear assembly, 301 or 315 series concealed ceiling regulator with cup and cap, and square connecting rod.
   e) Cover Plate Finish: Selected by Architect, from manufacturer's standard offerings including zinc plated, chrome plated, stainless steel, and primer painted.
9. Provide required operating wrenches for balancing, and furnish to the Owner at project completion.

2.3 IRIS DAMPERS

A. Manufacturers:
   1. Ruskin - VFBD35 Series.
   2. Continental Fan Manufacturing Inc. – Iris Series.
   3. FanTech - IR Series.

B. Galvanized steel construction, full circumferential neoprene or EPDM seals to inlet and outlet ducts, 6 CFM maximum casing leakage, permanent plastic or metal pressure taps, accuracy +/-5 percent. Frame shall fully encapsulate iris blade segments, and have rolled edges for strength. Blade segments shall be internally linked to an adjustment knob or lever with calibrated position indicator. Internal linkage fully encapsulated out of the airstream. Linear response of airflow to damper position. Designed for low self-noise generation.

C. Blades open fully for duct cleaning. Full airtight closure capability is not required unless indicated on the Drawings.

D. Installation Note: For precise metering of airflow, the iris damper should be located at minimum 1 diameter before or after an elbow, 3 diameters before a tee, 1 diameter after a tee, and 3 diameters before an outlet register.

2.4 DRIP PANS

A. Provide below humidifiers and their piping within the Special Collections rooms and as indicated, a stainless or galvanized steel drip pan not less than 18 ga with drain connections. Drip pans shall collect, confine, and dispose of leakage from humidifiers, including pipe and fittings. Slope pans toward the drain pipe connection(s) to ensure complete drainage.

B. Provide an enclosed receiver of translucent crack-resistant plastic such as polyethylene, 5 gallon capacity, with narrow top openings for venting, insertion of drip piping, and insertion and removal of the water-detecting sensor specified in Section 230900. Receiver may include a lifting handle. Wide-lid receivers such as buckets are not allowed.

2.5 DUCT ACCESS DOORS

A. Manufacturers:
1. Standard Doors:
a) Ruskin.
b) Air Balance, Inc.
c) Arrow.
d) Buckley Associates.
e) Cesco.
f) DuctMate.
g) Greenheck.
h) Nailor.
i) Vent Products, Inc.
j) Shop fabricated.

B. Fabricated in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings. Standard access doors may be shop-fabricated. Pressure rating shall be equal to the rating of the associated ductwork; see Part 3 Division 23 Section “Metal Ducts” for schedule of pressure classes.

C. Standard Doors: Removable, with retainer chain. Rigid and close-fitting with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 1 inch thick insulation with galvanized steel sheet metal airstream-side cover.
1. 16 inches Square and Smaller: Secure with two sash locks.
2. Over 16 inches , up to 24 inches Square: Provide four sash locks.
3. Larger Sizes: Hinges and two compression latches with outside and inside handles.
4. Clamping-type doors with knob handles, as manufactured by Ductmate, may be substituted for standard sizes.
5. Material: Galvanized steel in galvanized steel ductwork. Stainless steel in stainless steel ductwork. Aluminum as manufactured by Arrow in aluminum ductwork.
6. Provide in negative-pressure systems, and in positive-pressure systems with specified pressure class at or below 2 in. WG.

D. Access doors with sheet metal screw fasteners are not acceptable.

E. Sizing: Select sizes to allow testing, service, and maintenance within the ductwork. Such access may require the insertion of one or both hands, arms, and shoulders as appropriate.

Doors sized for viewing-only are not acceptable. Doors found to be of inadequate size shall be replaced with proper size.

2.6 DUCT SLEEVES, PREPARED OPENINGS AND CLOSURE COLLARS

A. Duct Sleeves and Closure Collars: Fabricate from minimum 20 ga galvanized steel or equivalent thickness of aluminum, select material to match duct material. Where sleeves are installed in bearing walls, provide structural steel sleeves.

B. Prepared Openings: Provide 1 inch clearance between the duct and the sleeve.

2.7 DUCT TEST HOLES

A. Manufacturers:
1. Ductmate.
2. Carlyle Corporation.
3. Duro-Dyne.
4. Ventfabrics.

B. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

C. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.8 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:
1. Ductmate.
2. Ventfabrics.
3. Duro-Dyne.
4. No substitutions.

B. Fabricate in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings.

C. Connector: Fabric crimped into metal edging strip.
1. Connectors shall be Ductmate PROFLEX Commercial series.
2. Fabric: UL listed coated woven glass fiber fabric meeting the requirements of NFPA 90A and NFPA 701. Resistant to weather and most chemicals, fat, grease, and oil. Neoprene coated, minimum density 30 oz per sq yd. Fire-retardant coating. Black color. Temperature range -40 to 200 degrees F.
3. Net Fabric Width: Approximately 3 inches wide.
4. Metal: 3 inch wide, 24 ga thick.
   a) Supply Ducts: G-60 galvanized steel.
   b) Exhaust Ducts Serving Fume Hoods: Type 316 stainless steel.
5. Connectors shall have double fold seams. Single fold seams (metal folded once only) shall not be accepted.

2.9 ROUND DUCT BRANCH TAPS AND SPIN-IN FITTINGS

A. Saddle Taps: For round ducts branching off main ducts at 90 degrees, provide factory fabricated, saddle-tap fittings with conical or bellmouth taps, or 45 degree rectangular-to-round branch fittings. For round ducts branching off at 45 degrees, fittings do not require conical or bellmouth expansion. Fittings shall be furnished with flange for fastening and sealing designed to overlap onto adjacent duct, and shall be shaped to fit tight to the exterior of the duct, flat for rectangular duct, curved for round duct.

B. Spin-in fittings, factory-fabricated with conical or bellmouth taps are an acceptable substitute for saddle taps.

C. Factory-fabricated taps and spin-ins may be furnished with integral volume dampers and quadrants as specified in paragraph “Manual Dampers” in this Section.

2.10 TURNING VANES

A. Manufacturers for Turning Vanes and Vane Rails:
1. Ductmate Industries - PROrail 2 inch Turning Vane Rail.
2. Duro Dyne - Junior Vane Rail.
3. Hardcast, a division of Carlisle Corporation - Dyn-O-Rail Jr.

B. Factory-fabricated and factory-or-field-assembled units consisting of curved turning vanes for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved single thickness vanes for mitered elbows with change in direction of 45 degrees or greater, conforming to SMACNA HVACDCS single vane schedule for small vanes. Each vane shall form a 90 degree arc. Fill the entire duct cross-section with vanes. Orient leading edge of vanes parallel to the side of the duct (directed straight into the entering airstream).

C. Turning vanes shall be minimum 16 gauge, regardless of gauges that are recommended by SMACNA. Double thickness turning vanes are not allowed.

D. Turning vanes in rectangular ductwork and shop-fabricated round ductwork shall conform with details on the Drawings. If not detailed, the SMACNA detail for small-radius small-spacing single-thickness vanes shall be used.

E. Turning vanes in manufactured round and flat oval duct elbows shall be the duct manufacturer’s standard size, spacing, and gauge, but must be single-wall and not less than 16 gauge.

F. Factory-fabricated turning vane rails shall be a minimum of 24 ga galvanized steel.

G. Material for vanes and rails shall be the same as the duct sheet metal.

2.11 WIRE MESH FOR SCREENS

A. Manufacturers:
1. McNichols Co.
2. Banker Wire and Iron Works, Inc.
3. Belleville Wire Cloth Co.

4. Edward J. Darby & Son, Inc.
5. No substitutions.

B. Galvanized Welded Wire Mesh: Hardware and industrial class welded wire square mesh, hot dipped galvanized, welded trimmed construction, 2 mesh (2 openings per inch, wires 1/2 inch on center), 0.0630 inch wire nominal diameter parallel to width and length, 0.437 inch openings, 76 percent open area, 0.51 lb/sq. ft weight. Specification is the minimum acceptable for strength and weight of materials.

C. Material to Match Ductwork: Where screens are installed in ductwork or louvers of other materials such as stainless steel or aluminum, provide screens of material to match the ductwork or louver, with strength equal to the requirements specified for galvanized mesh. Aluminum screens may be fabricated of expanded metal instead of welded wire.

D. Provide mesh installed in a removable frame to support the mesh completely flat and rigid, with fasteners in an accessible location.

2.12 UNIFORMITY OF MATERIALS

A. Ductwork accessories, including but not limited to volume dampers, backdraft dampers and motorized dampers, shall be fabricated of materials that are similar to the ductwork in which they are installed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVACDCS. Refer to Division 23 Section “Metal Ducts” for duct construction and pressure class.

B. Install components furnished under other Section and Divisions of the Specifications. Such items may include but are not limited to: Sensors and airflow measuring stations furnished under Division 23 Section “Instrumentation and Control for Mechanical Systems”; gauges and meters; and smoke detectors furnished under Division 26 – Electrical.

C. Provide duct access doors in horizontal return air, exhaust air and fresh air intake ductwork to facilitate the removal of accumulations of dust and combustible materials in accordance with NFPA 90A. Install access doors at maximum 20 foot intervals and at the base of each vertical riser.

D. Provide duct access doors for inspection, servicing, and cleaning before filters, before and after coils, before and after fans, before automatic dampers, at fire dampers, at smoke detector sampling tubes (upstream of the sampling tube), at multiple blade volume dampers, at backdraft

and counterbalanced dampers, and elsewhere as specified or as indicated on the Drawings. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as specified or as indicated on the Drawings. Review locations prior to fabrication.

E. Access doors installed for access to fire dampers and fire/smoke dampers shall be provided with identification with letters of minimum 1/2 inch height to indicate the presence of fire protection devices within. Conform with NFPA 90A and applicable Codes. Refer to Division 23 Section "Identification for HVAC Piping and Equipment" for labeling materials specifications.

F. Provide fire dampers at locations indicated, and where required by applicable Codes and regulations, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

G. Fire Damper Testing: Demonstrate operation and re-setting of each fire damper and fire/smoke damper to Owner's representative after installation and prior to building occupancy. Remove or melt the fusible link and allow the damper to close, then reopen the damper and replace the link. Repair or replace any damper which doesn't close and open properly. Coordinate with access door installation to ensure that access doors are of adequate size and location to allow required reach with 2 hands to hold the damper open while replacing the link.

H. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

I. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing.Provide balancing dampers on duct take-offs to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly. Where branch duct is completely above non-accessible wallboard ceiling and the Architect has not approved the use of access doors, provide remote manual operators.

J. For volume dampers located above suspended ceilings and in areas that are not visible to building occupants (such as mechanical rooms), provide fluorescent-orange colored surveyor's tape. Permanently attach tape to damper handles and run tape down to 10 in. above ceiling or 12 in. below damper handle where ceilings do not exist (e.g. mechanical rooms).

K. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and support by vibration isolators. Staple and seal connections airtight.

L. Duct Sleeves and Prepared Openings: Install for ducts passing through ceilings, walls, partitions, and floors. Field-determine the proper size and location of sleeves and prepared openings.
   1. Duct Sleeves: Allow one-inch clearance between duct and sleeve or one-inch clearance between insulation and sleeve for insulated ducts, except at grilles, registers, and diffusers.
   2. Prepared Openings: Allow one-inch clearance between duct and opening or one-inch clearance between insulation and opening for insulated ducts, except at grilles, registers, and diffusers.

M. Closure Collars:
1. Provide not less than 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed. Fit collars snugly around ducts. Grind smooth edges of collar to prevent tearing or puncturing insulation covering or vapor barrier.
2. Where insulated ducts penetrate non-fire-rated walls, insulation shall be continuous through the closure collars and the closure collars shall be installed tight to the insulation.
3. Where insulated ducts penetrate fire rated walls, insulate ducts on both sides of closure collars and seal points of contact between closure collar and insulation with vapor proof adhesive.
4. Where ducts penetrate fire rated walls, provide fire proof sealant at closure collar. Refer to Division 07 Section “Through Penetration Firestop Systems,” for fire proof sealant requirements.
5. Secure closure collars to ducts with sheet metal screws at maximum 6 inch centers and secure closure collars to walls or floors with sheetrock screws, nails or other appropriate fastener at maximum 6 inch centers.
6. Packing: Pack with non-combustible glass fiber insulation in spaces between sleeve/opening and duct/duct insulation. Cover or seal edges of packing to contain loose fibers.

N. Duct Hangers and Supports: SMACNA HVACDCS, Section 4. Hang ducts up to and including 36 inches in width by a minimum of 1 in x 16 ga flat straps on each side of the duct on 4 ft centers, bent under bottom of duct a minimum of 2 inches and securely fastened to duct. Hang ducts larger than 36 inches in width by 3/8 inch steel rods and 2 x 2 x 1/4-inch steel angle trapeze hangers, spaced 4 ft on center. Anchor risers in the center of the vertical run to allow ends of riser free vertical movements. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing.
1. Flexible Ducts: Support ducts by hangers every 3 feet, unless supported by ceiling construction. Stretch flexible air ducts to smooth out corrugations, and long radius elbows, where possible, using a minimum length to make connections.
2. Flexible Connectors: Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc-coated steel clinch-type draw-bands. For rectangular ducts, lock flexible connectors to metal collars.
3. Ducts with Extra Weight Such As Lead Lining or Lagging: Include the extra weight in determination of suitable hangers and supports.

O. Provide duct test holes where indicated and required for testing and balancing purposes.

P. Provide interconnecting power and control wiring as required, in accordance with Division 26.

END OF SECTION 233300

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers/Grilles.

C. Louvers.

D. Goosenecks.

E. Wall Vent Caps.

1.2 RELATED SECTIONS

A. Division 09 Sections “Interior Painting” and “Exterior Painting”: Painting of ductwork visible behind outlets and inlets.

1.3 REFERENCES

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

B. ADC 1062 - Certification, Rating and Test Manual.

C. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

D. AMCA 511 - Certified Ratings Program for Air Control Devices

E. ARI 650 - Air Outlets and Inlets.

F. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

G. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

H. ASTM E413 - Classification for Rating Sound Insulation.

I. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

J. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets indicating type, size, application, rated airflow, noise level, pressure drop, and throw distance as applicable. Submit both manufacturer's standard performance tables and graphs, AND tabulated selection data specific to this project. NOTE: Submittals without complete and sufficient information, to verify the performance specified and scheduled on the Drawings, shall be rejected.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section "Closeout Procedures."

B. Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Diffusers, Registers, Grilles:
1. Titus.
2. Anemostat.
3. Krueger.
4. Metalaire.
5. Price.

B. Louvers:
1. Greenheck.
2. Airolite.
3. American Warming and Ventilating.
4. Arrow.
5. Ruskin.
6. United Enertech.

C. Wall Vent Caps:
1. Dayton.
2. Luxury Metals.

3. Fan Manufacturer.

D. No substitutions.

2.2 RECTANGULAR CEILING DIFFUSERS

A. Type: Square and rectangular, multi-louvered directional diffuser to discharge air in pattern as indicated. Removable and interchangeable core for cleaning and changing patterns without tools.

B. Frame: Surface mount, inverted T-bar, snap-in, or spline type, as indicated and as required to be compatible with ceiling. In plaster ceilings, provide plaster frame and ceiling frame.

C. Fabrication: Aluminum with baked enamel off-white finish.

D. Accessories: Opposed blade damper and multi-louvered equalizing grid, with damper adjustable from diffuser face.

2.3 CONCENTRIC RING NOZZLE SUPPLY OUTLETS

A. Type: Concentric rings joined together with pivot axles allowing 60 degrees of rotation for directional control.

B. Frame: 1 inch) margin with countersunk screw mounting and gasket.

C. Fabrication: Aluminum extrusions with factory off-white enamel finish.

2.4 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical or horizontal face as indicated, double deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, as indicated, with factory off-white enamel finish.

D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

2.5 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical or horizontal face as indicated.

B. Frame: 1-1/4 inch margin with countersunk screwmounting.

C. Fabrication: Steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and

aluminum with 20 gauge minimum frame, or aluminum extrusions, as indicated, with factory off-white enamel finish.

D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.6 LOUVERS (4-INCH)

A. Louvers shall be equal to, and shall have free areas no less than, Greenheck Model EHH-401.

B. Free area velocity at beginning of water penetration shall be at least the velocity scheduled on the Drawings. Beginning of water penetration is defined by AMCA as 0.01 oz. per sq. ft. Test for water penetration in accordance with AMCA Standard 511, using a 48 in. x 48 in. louver.

C. Type: 4 inch deep with drainable blades on approximately 37 to 45 degree slope, heavy channel frame, removable expanded aluminum bird screen with 1/2 inch mesh mounted on interior face.

D. Fabrication: 0.081 inch thick 6063-T5 extruded aluminum alloy, welded assembly.

E. Mounting: Furnish with standard box frame and angles for installation. Provide outer flanges and other accessories to suit Architectural mounting details.

F. Finish: Factory 2-coat, 1.2-mil thickness 70 percent Kynar 500/Hylar 5000 fluoropolymer finish, with 10-year warranty. Submit manufacturer’s standard hard-copy color chart; the Architect will select color. Accessories visible from outdoors or exposed to the airstream, such as interior and exterior screens, shall have finish identical to the louver.

G. Louvers shall bear the AMCA rating seal for water penetration and air performance.

2.7 WALL VENT CAPS

A. Heavy gauge painted steel or aluminum vent with wall flange, bird screen, spring-loaded backdraft damper, foam weather stripping, throat size as indicated on the Drawings, tthroat extension into wall.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

C. Install outlets and inlets to ductwork with air tight connection.

D. Slope ducts or plenums at louvers, and at wall caps, to drain outward, and seal bottoms watertight.

E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

F. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09 Section "Painting."

G. Surfaces exposed to view shall be clean, and free of stains, smudges, and scratches.

END OF SECTION 233700

SECTION 234100 – PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Disposable Panel Filters.

B. Disposable, Pleated-Media Extended Area Panel Filters.

C. Extended Surface High Efficiency Mini-Pleated V-Bank Media Filters.

D. Filter Frames.

E. Filter Gauges.

1.2 RELATED SECTIONS

A. Division 01 Section “Temporary Facilities and Controls”: Filters for temporary heating and ventilating.

B. Division 26 Section “Equipment Wiring”: Electrical characteristics and wiring connections.

1.3 REFERENCES

A. ARI 850 - Commercial and Industrial Air Filter Equipment.

B. ASHRAE 52.2-2007 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

C. IEST - Recommended Practice IEST-RP-CC001.

D. ISO 14644-1 - Cleanrooms and Associated Controlled Environments.

E. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and related Products: Performance-Test Methods.

F. NFPA 70 - National Electrical Code.

G. UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.

H. UL 867 - Electrostatic Air Cleaners.

I. UL 900 - Test Performance of Air Filter Units.

1.4 DEFINITIONS

A. MERV: Minimum Efficiency Reporting Value, in accordance with ASHRAE Standard 52.2.

B. MERV-A: Minimum Efficiency Reporting Value, in accordance with ASHRAE Standard 52.2 Appendix J, using an aerosol to neutralize electrostatic charge.

1.5 PERFORMANCE TOLERANCES

A. Conform to ARI 850 Section 7.4.

B. Particle Size Efficiency: Plus or minus 5 percent, relative to the ASHRAE 52.2-2007 rating standards.

1.6 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittal Procedures.”

B. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.

C. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.

1.9 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Division 01 Section “Closeout Procedures.”

B. Provide one set of filters.

PART 2 - PRODUCTS

2.1 GENERAL

A. Filter efficiency (MERV) ratings shall be in accordance with ASHRAE Standard 52.2-2007. Filter ratings shall incorporate particle size vs. efficiency.

B. Particulate Filters (other than electrostatic precipitators):
   1. Ratings shall be MERV-A in accordance with the Standard's Appendix J (part of Addendum B, approved in 2008), which requires a conditioning step using a KCl aerosol to neutralize electrostatic charge.
   2. If the manufacturer has not completed MERV-A testing, submittals shall include a statement that the filtration and MERV rating are entirely mechanical and does not rely on an electrostatic charge.
   3. Fine fiber media, which maintain their efficiency over time, are required, as opposed to coarse-fiber media which rely on electrostatic charge and lose efficiency over time as the charge dissipates.

C. Gas-Phase filters such as activated carbon shall be rated for gas absorption, and installed with MERV-rated prefilters.

2.2 MANUFACTURERS

A. Filters, Frames, and Housings:
   1. Camfil Farr.
   2. AAF International (American Air Filter and AAF brands).
   3. Airguard - a Clarcor company.
   4. Cleanrooms International (products: ceiling HEPA filter housings and fan-filter units).
   5. Columbus Industries (product: Polysorb carbon filtration).
   6. Eco-Air - division of Flanders Corporation.
   7. Fiberbond Corporation.
   8. Flanders Corporation.
   9. GlasFloss Industries.
   10. Purolator - a Clarcor company.
   11. No substitutions.

B. Gauges:
   1. Dwyer.

2.3 DISPOSABLE, PLEATED-MEDIA EXTENDED AREA PANEL FILTERS

A. Product: Camfil Farr 30-30.

B. Media: UL 900 Class 2, pleated, lofted, non-woven, reinforced cotton and synthetic fabric; supported and bonded to wire grid.
   1. Frame: High-wet-strength beverage board.
   2. Pleats: Rounded radial type for full usage of media area.
   3. Nominal thickness: 2 inches, unless otherwise indicated.

C. Performance Ratings: Ratings below are for the MERV noted. Provide other MERV ratings where indicated on the Drawings.
   1. MERV (ASHRAE 52.2): 8.
   2. MERV-A (ASHRAE 52.2, Appendix J): 8.
   3. Maximum Initial Resistance:
      a. At 350 Fpm Face Velocity:
         1) 1 inch thick Filter: 0.23 inch WG.

b. At 500 Fpm Face Velocity:
   1) 2 inch thick Filter: 0.31 inch WG.
   2) 4 inch thick Filter: 0.27 inch WG.
4. Recommended Final Resistance: 1.0 inch WG.
5. Guaranteed Pressure Drop Without Failure: 2.0 inch WG.
6. Maximum Operating Temperature: 180°F continuous, 200°F intermittent.
7. Total Media Area, 24 inch x 24 inch Nominal Size:
   a. 1 inch (12.5 mm) Thick: 9.8 sq. ft.
   b. 2 inch (25 mm) Thick: 17.3 sq. ft.
   c. 4 inch (25 mm) Thick: 27.7 sq. ft.

2.4 FILTER FRAMES AND HOUSINGS

A. Universal Holding Frame:
   1. Product: Camfil Farr Type 8 holding frame.
   2. Universal holding frames shall be constructed of not less than 16 ga galvanized steel (stainless steel construction shall be not less than 20 ga). They shall be equipped with polyurethane foam gaskets, fasteners, and integral filter element centering devices.
   3. The four sealing flange corners shall be flush mitered. The in-line depth shall not be less than 2.69 in..
   4. Filter fasteners shall be capable of being installed without the requirements of tools, nuts, or bolts and providing 100 lb of sealing force on the filter against the frame's gasket. The holding frame shall be designed to accommodate standard size filters of a variety of types and manufacturers.
   5. Frames shall be equal to Farr Type 8 Universal Holding Frames.

2.5 FILTER GAUGES

A. Product: Dwyer Magnehelic.

B. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated magnet with helix and dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-0.5 inch WG or 0-1.0 inch WG to suit application, 2 percent of full scale accuracy.

C. Accessories: Static pressure tips with integral compression fittings, 1/4 inch aluminum tubing, 2-way or 3-way vent valves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.

D. Provide new filters in air handling systems immediately before the systems are balanced by the approved balancing contractor. Air handling systems shall be balanced with clean filters.

E. Do not operate fan system until filters (temporary or permanent) are in place. Once air handling systems are in operation and before substantial completion, provide filter replacement as required. Filters shall be replaced when their pressure drop (as measured by the approved balancing contractor) reaches the manufacturer's recommended changeout pressure drop. At the time of substantial completion, provide air handling systems with a new set of filters. After substantial completion, provide any air handling systems that are subjected to significant dust and debris as a result of continued construction with filter changeouts as specified above, and provide new filters when construction is completed.

END OF SECTION 234100

SECTION 235216 - CONDENSING BOILERS

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 packaged, factory-fabricated and assembled, gas-fired, condensing boilers, trim, and accessories for generating hydronic heating-system hot water.

1.3 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Source quality-control test reports.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

F. Other Informational Submittals:
1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years' experience.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

E. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

F. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

G. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

H. Source Quality Control: Test and inspect boilers according to the ASME Boiler and Pressure Vessel Code, Section IV. Boilers shall be test fired in the factory, and a report attached permanently to the exterior cabinet of the boiler for field reference.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers which fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Condensing Boilers: Leakage and Materials: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONDENSING BOILERS

A. Manufacturers:

   1. Aerco – AM Series.
   2. Fulton – Endura XE (EXE) product line.
   3. Lochinvar – FTXL product line.
   4. Raypak XVERS L product line.
   5. Viessmann – Vitocrossal 200 CI2 product line.
   6. No substitutions.

B. General Description: Factory-fabricated-and-assembled, factory-pressure tested condensing boiler with heat exchanger sealed pressure tight, built on a steel floor-mounting base, including insulated jacket, flue-gas vent, combustion-air intake connections, water supply, return, condensate drain connections, and controls. Water heating service only.

C. Certification: ASME Section IV pressure vessel code, stamped and certified.

D. Heat Exchanger: Stainless steel, downfired fire tubes or horizontal-fired radial style, all-welded construction.

E. Pressure Vessel: Carbon steel, with inspection openings in accordance with ASME Section IV pressure vessel code. Arranged to fully drain by gravity; servicing must not require pumped flushing of the pressure vessel or other components.

F. Burner: Natural gas, sealed combustion, forced draft. Stainless steel knitted micrometal metal fiber, vertical mounted.

G. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber. Modulation by variable frequency drive or equivalent.

H. Motors: Sized large enough so driven load will not require motor to operate in service factor range above 1.0.

I. Gas Train: Combination gas valve providing slow opening and fast closing with proportional air/gas ratio control. Fast closing safety shutoff pressure regulator. Low pressure and high pressure gas safety switches. Manual shutoff valve.

J. Ignition: Spark or proven-pilot ignition with electronic flame supervision, pre-purge and post-purge.

K. Casing: Plastic and sheet metal, fully removable without the need for tools, providing access for cleaning fire tubes and water-side of heat exchanger. Glass fiber insulation surrounding the heat exchanger. Vent manifold and combustion air connections with collars.

L. Trim:

1. Provide devices sized to comply with ANSI B31.9, "Building Services Piping."
2. Safety Relief Valve: ASME rated. Setting as scheduled on the Drawings.
3. Flow switch for field installation.
4. Pressure and Temperature Gage: Minimum 3-1/2 inch diameter, combination water pressure and temperature gage. Gage shall have operating ranges selected so that normal operating range is about 50 percent of full range.
5. Drain Valve: Minimum NPS 3/4 hose-end ball or gate valve. Sized as required by applicable State and local Codes and regulations.

M. Controls:

1. Integral control with multicolor graphic LCD display and navigation devices.
2. Outdoor sensor, and water reset controller.
3. Pump contacts and power supply for boiler pump.
4. System temperature sensor input contacts.
5. On-off switch.
6. Adjustable manual-reset high limit control.
7. Automatic-reset high limit control.

N. Venting Kits:
1. Exhaust: Complete system of material indicated on the Drawings, with pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and condensate neutralization (dilution) tank, and sealant.
2. Combustion-Air Intake: Complete system of material indicated on the Drawings, with pipe, vent terminal with screen, inlet air coupling, and sealant.

2.2 LOW-WATER CUT OFF

A. Manufacturers:
1. McDonnell & Miller - Model 751P-MT-120.
2. Hydrolevel Company – Safgard Model 550.

B. Probe-type control to prevent burner operation when boiler water falls below safe level, with manual reset button with memory circuit to meet the requirements of ASME CSD-1, test button, green power indicator LED, red low water LED, probe to fit threaded pipe connection, and NEMA 1 enclosure. Power failures and air bubbles will not cause a lockout, and power failures will not cause the control to come out of a low-water lockout. Maximum water pressure 160 psig. UL and CSA listed, FM approved.

C. Low-Water Cutoff shall be mounted in piping external to the boiler, and shall be in addition to any low-water protection devices furnished integral to the boiler.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Install boilers level on concrete housekeeping base, sized at least 4 inches larger than boiler base. Fasten boiler to base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

B. Install, start, and test boilers and their accessories in accordance with the manufacturer’s instructions and these Specifications. In the case of conflicting instructions, the more stringent shall apply.

C. Install gas-fired boilers according to NFPA 54.

D. Assemble and install boiler trim.

E. Assemble and install boiler accessories

F. Install electrical devices furnished with boiler but not specified to be factory mounted.

G. Provide control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler with clearances and fittings to allow service and maintenance.

C. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

D. Pipe safety relief valves to above floor at height indicated and as required by Code. Piping shall be at least full size of connection. Do not combine piping from individual valves, unless recommended and sized by the boiler manufacturer.

E. Boiler Venting:
1. Install flue venting kit and sealed combustion-air intake.
2. Connect full size to boiler connections.

F. See Division 23 Section “Facility Natural-Gas Piping” for gas piping. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
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.

B. Tests and Inspections:
1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
    b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. 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 2 visits to Project during other than normal occupancy hours for this purpose.

E. Performance Tests:
1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.
    a. Test for full capacity.
    b. Test for boiler efficiency at low fire and 100 percent of full capacity. Determine efficiency at each test point.
4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Owner’s representative in advance of test dates.
8. Document test results in a report and submit to Architect.

3.5 START-UP, INSTRUCTION AND WARRANTY SERVICE

A. The factory-authorized representative shall provide start-up and instruction of each new boiler, including burner and boiler control system as specified herein. Start-up and instruction shall cover components assembled and/or furnished by the manufacturer, whether or not of their own manufacture.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 235216

SECTION 235700 – HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Heat exchangers for hydronic systems.

B. Plate type heat exchangers.

C. Accessories and trim.

1.2 RELATED SECTIONS

A. Division 23 Section “Hydronic Piping.”

B. Division 23 Section “Hydronic Specialties.”

C. Division 23 Section “Instrumentation and Controls for Mechanical Systems.”

1.3 REFERENCES

A. ANSI/ASME - Boilers and Pressure Vessels Code.

1.4 REGULATORY REQUIREMENTS

A. Conform to Section 8D of the ANSI/ASME Boilers and Pressure Vessels Code for manufacture of tubular heat exchangers and heat exchanger shells.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.6 SUBMITTALS

A. Submit Shop Drawings and product data under provisions of Division 01 Section “Submittal Procedures.”

B. Indicate dimensions, locations, and size of tappings and performance data.

C. Submit manufacturer's installation instructions.

D. Submit design data in sufficient detail to verify that heat exchangers meet or exceed specified requirements.

E. Submit test reports of tube bundle pressure tests.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Include start up and shut down instructions, assembly drawings, and spare parts lists.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01 Section “Product Requirements.”

B. Store and protect products under provisions of Division 01 Section “Product Requirements.”

C. Protect internals from entry of foreign material by temporary caps on flanged openings.

PART 2 - PRODUCTS

2.1 PLATE TYPE HEAT EXCHANGERS – BRAZED TYPE

A. Manufacturers:
1. Taco.
2. Armstrong.
3. Bell & Gossett.
4. GEA PHC Systems.

B. Plates: Embossed with a specific heat transfer surface. Stainless steel Type 316.

C. Brazing Alloy: 99 percent copper.

D. Nozzles: Male NPT thread, stainless steel Type 316.Mounting Studs: Threaded stainless steel Type 316, brazed or welded to outer plate.

E. Maximum Working Pressures and Temperatures:

F. U.L. Listed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install to permit removal of heat exchanger with minimum disturbance to installed equipment and piping.

C. Pipe relief valves to nearest floor drain.

3.2 WATER TO WATER HEAT EXCHANGER TRIM

A. Water Inlets and Outlets: Thermometer wells, pressure gauge tappings.

B. Heated Water Outlet: Thermometer well for temperature regulator sensor, ASME rated pressure relief valve, valved drain.

END OF SECTION 235700

SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Condensing unit package.

B. Charge of refrigerant and oil.

C. Controls and control connections.

D. Refrigerant piping connections.

E. Motor starters.

F. Electrical power connections.

1.2 RELATED SECTIONS

A. Division 01 Section “Cast-in-Place Concrete”: Concrete bases.

B. Division 23 Section “Common Motor Requirements for HVAC Equipment.”

C. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment”: Placement of vibration isolators.

D. Division 23 Section “Refrigerant Piping.”

E. Division 23 Section “Convection Heating and Cooling Units”: Blower Coil units.

F. Division 23 Section “Instrumentation and Control for Mechanical Systems” - Sequence of Operation.

G. Division 26 “Electrical.”

1.3 REFERENCES

A. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

C. ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.

D. ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units.

E. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

F. ASHRAE 90A - Energy Conservation in new Building Design.

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

H. NEMA MG 1 - Motors and Generators.

I. UL 207 - Refrigerant-Containing Components and Accessories, Non-Electrical.

J. UL 303 - Refrigeration and Air-Conditioning Condensing, and Air-Source Heat Pump Equipment.

1.4 SUBMITTALS

A. Division 01 Section “Submittal Procedures”: Procedures for submittals.

B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections.

C. Product Data: Provide rated capacities, weights specialties and accessories, electrical nameplate data, and wiring diagrams.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Division 01 Section “Closeout Procedures”: Procedures for submittals.

B. Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

C. Protect units on site from physical damage. Protect coils.

1.9 WARRANTY

A. Provide a 5-year warranty for refrigerant compressors.

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. Copeland.

2.2 MANUFACTURED UNITS

A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, wind deflector as necessary, and screens, with components and accessories as scheduled on the Drawings.

B. Construction and Ratings: In accordance with ARI 210/240, ARI 365 and UL 207 and UL 303. Testing shall be in accordance with ASHRAE 14.

C. Performance Ratings: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE 90A.

2.3 CASING

A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish, or equivalent corrosion protection.

B. Mount starters and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

C. Provide removable access doors or panels with quick fasteners and piano hinges or equivalent.

2.4 CONDENSER COILS

A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig, and dehydrate.

B. Coil Guard: PVC coat steel wire or equivalent.

2.5 FANS AND MOTORS

A. Horizontal or vertical discharge direct driven propeller type condenser fans with fan guards on inlet and discharge.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or better, with permanent lubricated ball bearings and built in current and thermal overload protection.

C. Motors as indicated, in compliance with Division 23 Section “Common Motor Requirements for HVAC Equipment.”

2.6 COMPRESSORS

A. Compressor: Hermetic digital scroll type.

B. Mounting: Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators. Internally isolate hermetic units on springs.

C. Lubrication System: Oil pump with oil charging valve, oil level sight glass, and magnetic plug or strainer.

D. Motor: Suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting. Furnish with starter.

E. Capacity Reduction Equipment: Compressor and fan speed modulation, controlled from room thermostat. Hot gas bypass as necessary.

F. Suction-Line Liquid Injection: To cool the compressor, allowing lower-temperature operation and high compression ratio.

G. Crankcase Heater: To maintain minimum oil temperature.

2.7 REFRIGERANT CIRCUIT

A. Provide each unit with one refrigerant circuit, factory supplied and piped. Refer to Division 23 Section “Refrigerant Piping.”

B. Provide:
1. Refrigerant accumulator.
2. Filter dryer.
3. Liquid line sight glass and moisture indicator.
4. Insulated suction line.
5. Suction and liquid line service valves and gage ports.
6. Charging valve.
7. Discharge line check valve.
8. Compressor discharge service valve.
9. Condenser pressure relief valve.
10. Liquid line solenoid valve.
11. Thermal expansion valve for maximum operating pressure, for mounting at indoor coil.

2.8 RECEIVER

A. Mounted within condensing unit, with valve, heater, and insulation, sized as necessary for proper system performance, with custom sizing to minimize refrigerant charge to comply with the refrigerant concentration limits within indoor spaces required by ASHRAE standards.

B. Submit sizing calculation.

2.9 REFRIGERANT AND OIL

A. Refrigerant and oil must be compatible with the indoor coil, and comply with product specifications in Division 23 Section “Refrigerant Piping and Specialties.”

B. Provide charge necessary for the refrigerant circuit including this unit, indoor and outdoor piping, and the indoor coils.

2.10 CONTROLS

A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, factory wired with single point power connection. Provide electronic controller with digital display and two-way communication to the building automatic temperature control system. Provide control transformer to power the controller and other controls, enabling single-point power supply to the entire condensing unit.

B. Provide Copeland CoreSense diagnostics module for monitoring and protecting the compressor, including fault alerts, digital unloading, liquid injection control, and monitoring of discharge line temperature and electric current. LED lights for local fault-code indication, RS485 connector for Modbus network communication, and DIP switches for settings.

C. For compressor, provide power control with speed modulation, non-recycling compressor overload, and starter relay or equivalent. For condenser fan, provide power control with speed modulation. Provide manual reset current overload protection and other safety devices recommended by the manufacturer to shut down the compressor and prevent further damage. Provide pressure controls, adjustable for low limit, fixed for high limit.

D. Provide controls to permit operation down to -13 ºF (below zero F) ambient temperature and as scheduled on the Drawings.

E. Provide defrost control, to cycle compressor and fan as necessary to defrost the indoor coil in air-defrost mode.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.

C. Provide for connection to electrical service. Refer to Division 26.

D. Install units on vibration isolation. Refer to Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

E. Install units on concrete base as indicated. Refer to Division 01 Section “Submittal Procedures.”

F. Provide connection to refrigeration piping system and evaporators. Refer to Division 23 Section “Refrigerant Piping.” Comply with ASHRAE 15.

G. Furnish charge of refrigerant and oil.

3.2 DEMONSTRATION AND INSTRUCTIONS

A. Division 01 Section “Closeout Procedures”: Demonstrating installed work.

B. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period.

C. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.

D. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

E. Provide cooling season start-up, and winter season shut-down for first year of operation.

F. Inspect and test for refrigerant leaks every 2 months during first year of operation.

END OF SECTION 236200

SECTION 237200 – AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged Air-to-Air Energy Recovery Units.

1.2 RELATED SECTIONS

A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”

B. Division 23 Section “Identification for HVAC Piping and Equipment.”

C. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

D. Division 23 Section “Duct Insulation.”

E. Division 23 Section “Particulate Air Filtration.”

F. Division 23 Section “Air Duct Accessories”: Flexible duct connections.

G. Division 23 Section “Instrumentation and Control for Mechanical Systems” - Sequence of Operation.

H. Division 26 “Electrical.”

1.3 REFERENCES

A. Division 01 Section “Quality Requirements” and Division 01 Section “References”: Requirements for references and standards.

B. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.

C. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings.

D. AMCA 99 - Standards Handbook.

E. AMCA 210 - Laboratory Methods of Testing Fans for Rating.

F. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

H. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

I. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

J. ANSI/UL 900 - Test Performance of Air Filter Units.

K. ARI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.

L. ARI 430 - Standard for Central-Station Air-Handling Units.

M. ARI Guideline D - Application and Installation of Central Station Air-Handling Units.

N. ARI 610 - Central System Humidifiers.

O. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.

P. NEMA MG1 - Motors and Generators.

Q. NFPA 70 - National Electrical Code.

R. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

S. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

T. UL 900 - Standard for Air Filter Units.

U. UL - Fire Resistance Directory.

V. UL 1995 - Heating and Cooling Equipment

1.4 SUBMITTALS

A. Division 01 Section “Submittal Procedures”.

B. Product Data:
1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, operation and service clearances, and electrical characteristics and connection requirements. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring. Include recommended wire and fuse sizes or MCA, sequence of operation, connection points, safety and start-up instructions.
6. Submit unit performance including: capacity, nominal and operating performance.
7. Submit Mechanical Specifications for unit and accessories describing construction, components and options.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Division 01 Section “Closeout Procedures”: Procedures for submittals.

B. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.6 QUALITY ASSURANCE

A. Energy Recovery Units: Product of manufacturer regularly engaged in production of components, who issues complete catalog data on product offering. Manufacturer shall have minimum 3 years’ experience.

B. Energy Recovery Units: Certify air volume, static pressure, fan speed, brake horsepower and selection procedures in accordance with ARI 430. If air handling units are not certified in accordance with ARI 430, Contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fans. Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the Contractor.

C. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with ARI 410-91.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.

B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units shipped not fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Each section shall have lifting lugs to allow for field rigging and final placement of section.

C. Deliver units to site with fan motors, sheaves, and belts completely assembled and mounted in units.

D. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

E. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.

B. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.10 EXTRA MATERIALS

A. Division 01 Section “Closeout Procedures.”

B. Provide 1 set of filters for each unit, to the Owner in clean, sealed containers.

PART 2 - PRODUCTS

2.1 OUTDOOR AIR-TO-AIR HEAT RECOVERY UNITS

A. Approved Manufacturers:
1. RenewAire.

B. General:
1. Factory assembled unit, base mounted, with connections to building ducts mounted on one end, consisting of fan and motor assemblies (supply and exhaust), Air-To-Air Plate Heat Exchanger, necessary dampers, hoods, plenums, filters, wiring and controls. Unit shall be stand-alone controlled (with start/stop signal from the building’s automatic temperature control system) with control devices provided by unit manufacturer. Unit shall have single point power connection. Provide contact points as required for interface of start/stop signal from the building’s automatic temperature control system - coordinate with Division 23 – Instrumentation and Control for Mechanical Systems.
2. Motor and Electrical Components: Refer to Division 23 – Common Motor Requirements for HVAC Equipment for motor requirements.

C. Unit Cabinet:
1. The unit base frame shall be constructed from formed steel or structural channels with internal structural cross members properly sized to allow rigging and handling of the unit. Major components shall be supported by the base without sagging or pulsating.
2. Unit construction shall be of insulated steel with painted outer surfaces. Bottom of unit shall be internally insulated and enclosed in sheet steel for mounting on raised stand.
3. Provide support legs with braces.
4. Provide full size access doors located to allow periodic maintenance and inspections. Doors shall be insulated steel with heavy duty corrosion proof hinges, latches, and gaskets, with cross-core differential pressure testing ports.
5. Defrost and Drain Pan: Unit shall not require a defrost cycle or condensate drainage, at the anticipated weather conditions at the project site.

D. Air-To-Plate Heat Exchanger: Cross-flow type fabricated with materials allowing enthalpy (heat and humidity) transfer between the airstreams..

E. Fans: Direct-driven, statically and dynamically balanced for continuous operation at maximum fan speed and power.

F. Motors: Electronically commutated, totally-enclosed fan-cooled (TEFC) with devices to adjust

and set speeds.

G. Filters: As scheduled on the Drawings, in accordance with Division 23 Section “Particulate Air Filtration” including differential-pressure gauges.

H. Controls:
1. Onboard controls including terminal strips and contactors as required for fan control, and speed adjustment devices for varying and setting fan speeds during testing and balancing.
2. Filter differential-pressure monitors to provide dirty-filter signals to the building temperature control system.
3. Field-furnished control devices as scheduled and indicated on the Drawings.

I. Warranty: Manufacturer’s standard.

J. Vibration Isolation: Spring type under the unit, with baseframe as necessary, in accordance with Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Division 01 Section “Quality Requirements”: Manufacturer's instructions.

B. Isolate unit connections from ductwork with flexible duct connections; refer to Division 23 Section “Air Duct Accessories.” Ensure metal bands of connectors are parallel with at least 1 inch flex between ductwork and fan while running.

C. Install assembled unit on raised steel frame with spring vibration isolators; fasten frame to concrete pad. Fasten with largest hex-head fasteners that the mounting holes allow. Install isolated unit with flexible electrical leads. Refer to Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.” Adjust isolators to prevent tension in flexible connectors when fan is operating.

3.2 TESTING

A. After the entire installation is completed, ready for operation, test the systems. The Owner will provide electric current for the tests. Provide necessary labor, gauges, meters, other instruments and materials. Perform tests in the presence of the Architect. Dampers and fan speed controllers shall operate smoothly through their entire range. Unit shall operate without objectionable noise.

3.3 CLEANING

A. The entire system installations including apparatus, motors, inside of ducts, and other components, shall be prepared for Owner’s use including cleaning and lubricating.

B. Provide air filters at system start-up. Replace filters after air systems have been adjusted and balanced. Provide the Owner with 1 additional set of air filters.

3.4 ADJUSTMENTS

A. After installation, furnish technicians for the adjustment and operation of the system, and turn it over to the Owner in perfect working order. Instruct the Owner's authorized representative in the care and operation of the installation, providing written instructions, and other relevant information and documentation.

3.5 NAMEPLATES AND TAGS

A. Provide engraved plastic nameplates to identify equipment, controls, and other components in accordance with Division 23 Section “Identification for HVAC Piping and Equipment.” Provide nameplates secured to each ventilating unit indicating quantities, sizes, and MERV ratings of filters required.

END OF SECTION 237200

SECTION 238126 – SPLIT-SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Air Conditioning Units.

B. Heat Pump Units.

C. Controls and Control Panels.

1.2 RELATED SECTIONS

A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”

B. Division 23 Section “Identification for HVAC Piping and Equipment.”

C. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

D. Division 23 Section “Refrigerant Piping.”

1.3 REFERENCES

A. ANSI/ASME - Boilers and Pressure Vessels Code.

B. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

D. UL - Underwriters' Laboratories.

E. NFPA 70 - National Electric Code.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A for the installation of Computer Room air conditioning units.

1.6 SUBMITTALS

A. Submit Shop Drawings and product data under provisions of Division 01 Section “Submittal Procedures.”

B. Submit product data for manufactured products and assemblies required for this project.

C. Indicate water, drain, electrical and refrigeration rough-in connections on Shop Drawings or product data.

D. Submit manufacturer's installation instructions under provisions of Division 01 Section “Submittal Procedures.”

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Include manufacturer's descriptive literature, operating instructions, installation instructions and maintenance and repair data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Daikin.

B. Fujitsu.

C. LG.

D. Mitsubishi.

E. Trane.

2.2 GENERAL

A. Ductless systems shall consist of compact wall-mounted and floor-mounted packaged evaporator sections, a distribution branch box, and matching air-cooled outdoor heat-pump unit.

B. Ducted systems shall consist of a horizontal ducted packaged evaporator section, and matching air-cooled outdoor heat-pump unit.

C. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

D. Wiring shall be in accordance with the National Electrical Code (N.E.C.).

E. The units shall be rated in accordance with ARI Standard 210 and bear the ARI label.

F. A full charge of refrigerant and oil for refrigerant tubing shall be provided in the condensing unit. Tubing length shall be provided as required (coordinate with Drawings). A holding charge shall be provided in the evaporator.
   1. Refrigerants shall comply with Division 23 Section “Refrigerant Piping.”
   2. Submit calculations to demonstrate conformance to ASHRAE limits on concentration of refrigerant in indoor spaces.
   3. Provide refrigerant sensor(s) where required by applicable Codes and regulations.

G. Unit shall be U.L. approved and shall bear a U.L. label.

2.3 INDOOR UNITS, WALL-MOUNTED AND FLOOR-MOUNTED

A. The indoor unit shall be completely factory assembled and wired.

B. The casing shall have a white finish.

C. The evaporator fan shall be a high performance, forward curve line flow fan direct driven by a single motor. The fan shall be statically and dynamically balanced and run on permanently lubricated bearings.

D. An adjustable change vane shall be provided with the ability to direct the air flow from horizontal to vertical. An adjustable guide vane shall be provided to manually change the air direction from left to right.

E. The evaporator coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. Tube joints shall be brazed with phoscopper or silver alloy. The coils shall be pressure tested at the factory.

F. A condensate pan with drain shall be provided under the coil.

G. The unit shall include washable filters.

2.4 INDOOR UNITS, DUCTED

A. The indoor unit shall be completely factory assembled and wired.

B. The casing shall be unpainted steel for concealed mounting, with supply and return duct collars.

C. The evaporator fan shall be a high performance, forward curve line flow fan direct driven by a single motor. The fan shall be statically and dynamically balanced and run on permanently lubricated bearings. Controls shall include adjustable settings for speed and external static pressure.

D. The evaporator coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. Tube joints shall be brazed with phoscopper or silver alloy. The coils shall be pressure tested at the factory.

E. A condensate pan with drain shall be provided under the coil. An integral condensate lift device shall raise condensate to a height above the unit casing. Provide flexible hose and clamps to transition to rigid piping.

F. The unit shall be powered from the outdoor unit. See “Outdoor Unit” in this Section for more information.

G. Filters: Provide a filter box as described on the Drawings for mounting in the return ductwork; box must fit the available space including service clearances, and may be shop fabricated or furnished by the indoor unit manufacturer. Provide 2-inch thick pleated-media filters with rating at least MERV-8 in accordance with Div. 23 Section “Particulate Air Filtration.”

2.5 OUTDOOR UNITS

A. The outdoor unit shall be completely factory assembled, piped, wired, and shall carry a complete refrigerant charge.

B. The casing shall be fabricated of galvanized steel, bonderized and finished with baked enamel.

C. The unit shall be furnished with a direct drive, propeller type fan arranged for horizontal discharge.

D. The motor shall have inherent protection, be of the permanently lubricated type and resiliently mounted for quiet operation.

E. The fan shall be provided with a raised wire guard to prevent contact with moving parts.

F. The compressor shall be of the high-performance serviceable rotary type with crankcase heater, accumulator and internal thermal overloads. The compressor shall be internally isolated with rubber mounts so as to avoid the transmission of vibration.

G. The refrigeration system shall have the capability to operate with a maximum height difference and overall refrigerant tubing length between indoor and outdoor sections as indicated on the Drawings without the need for line size changes, traps, or additional oil. Refrigerant flow from the condenser shall be controlled by means of a capillary tube or equivalent.

H. The condenser coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. The coil shall be protected with an integral metal guard.

I. The unit shall be controlled by the microprocessor located in the matching indoor unit or branch box. The outdoor unit shall have the ability to provide power for the matching indoor unit or branch box. The unit electrical power shall be as scheduled on the Drawings.

J. The unit shall be capable of low ambient operation, with wind baffles and other accessories to meet the conditions indicated on the Drawings.

K. Support: Stainless steel factory-fabricated stand; feet with mounting holes.

L. Heat Pump Units: The unit shall include valves and controls for automatic changeover from cooling to heating mode.

2.6 SYSTEM CONTROL

A. The control system shall consist of two microprocessors interconnected by a multi-wire cable. One microprocessor shall be factory wired and located within the indoor unit. It shall have the capability of sensing room temperature and indoor coil temperature; receive and process commands from the remote controller; and control the outdoor unit. Wireless remote controllers are not acceptable.

B. The microprocessor within the wall-mounted remote monitor and controller shall display setpoint and room temperature; provide two manually selected modes of cooling, normal and economy operation at 2 degrees F above setpoint; provide continuous or automatic start/stop of system operation; night setback operation of 4 degrees F above setpoint; and manual or automatic fan speed control. Automatic fan speed control shall be based upon the temperature difference between setpoint and room temperature maintaining lowest speed possible.

C. When heating capability is specified, the wall-mounted controller shall provide manually selected modes of heating, and night setback operation of 4 degrees F below setpoint.

2.7 REFRIGERANT PIPING

A. Unit shall be provided with pre-charged line sets as recommended by the manufacturer, or field-furnished piping, as necessary. Piping shall be field-insulated with elastomeric type insulation as specified and indicated.

2.8 WARRANTY

A. The units shall have a manufacturer's warranty for a period of 1 year from date of Substantial Completion.

B. The compressor shall have a warranty of 5 years from date of Substantial Completion.

C. If any part fails to function properly during the warranty period due to defects in workmanship or material, it shall be replaced or repaired.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that system is located per Drawings.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Mount ground-mounted air-cooled condensing units at least 24 in. above grade. Attach stands to support pads with stainless-steel fasteners.

C. Provide recessed wall mounting box for mounting the wired indoor controller. Fasten the box to wall framing stud, masonry, or other suitable structural surface approved by the Architect; fastening to gypsum wallboard is not acceptable. Provide interconnecting low-voltage and line-voltage wiring and conduits, concealed unless otherwise indicated. Wall mounting box, wiring, and conduits shall be in accordance with the requirements of Division 26 – Electrical.

END OF SECTION 238126

SECTION 238200 – CONVECTION HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Baseboard Radiation.

B. Blower Coils.

C. Cabinet Unit

D. Wall and Kickspace Heaters.

E. Finned Tube Radiation.

1.2 RELATED SECTIONS

A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”

B. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

C. Division 23 Section “Identification for HVAC Piping and Equipment.”

D. Division 23 Section “Hydronic Piping.”

E. Division 23 Section “Hydronic Specialties.”

F. Division 23 Section “Refrigerant Piping.”

G. Division 23 Section “Packaged Compressor and Condenser Units.”

H. Division 23 Section “Instrumentation and Control for Mechanical Systems.”

I. Division 26 “Electrical” - Equipment Wiring Systems: Electrical characteristics and wiring connections. Electrical supply to units.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Division 01 Section “Submittal Procedures.”

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:
   1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.

2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
3. Indicate mechanical and electrical service locations and requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Division 01 Section “Closeout Procedures”: Procedures for submittals.

B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 BASEBOARD RADIATION, COMMERCIAL/INSTITUTIONAL GRADE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Sterling Hydronics – a division of Mestek, Inc.
2. Vulcan Radiator – a division of Mestek, Inc.
3. Slant-Fin.
4. Zehnder Rittling.

B. Heating Elements: 3/4-inch ID seamless copper tubing, mechanically expanded into evenly spaced aluminum fins, suitable for soldered fittings. Galvanized steel slide cradles.

C. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

D. Enclosures: Slope-top, stamped-louvered, pencil-proof, 16-gauge steel, with easily jointed components for wall-to-wall installation.

E. Backplate: 20-gauge steel, painted. Full type, for use with wire hangers. Support rigidly on wall. Mount at manufacturer's recommended height above floor.

F. Finish: Factory applied baked enamel of color as selected by the Architect.

2.2 BLOWER COIL UNITS

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. Trane.
2. Enviro-Tec.
3. Johnson Controls.
4. Price Industries.
5. Titus.

B. Casing: Heavy gauge galvanized steel with inlet and outlet duct collars, and provisions for mounting feet for vertical units or threaded hanging rods for horizontal units, as applicable. Casing shall be fully insulated to prevent unit sweating and attenuate fan noise. Casing shall have access panels on the most approachable side, as indicated on the Drawings.

C. Electrical Raceway: Unit shall have an electrical raceway providing a single location for field wiring connections. Factory mounted electrical components shall have wire leads terminating in the unit raceway.

D. Hot Water Coils: Serpentine style with piping connections on the side of the unit casing for minimal headroom, seamless copper tubing, with evenly spaced aluminum fins mechanically bonded to tubing. Tested at 200 psig.

E. Refrigerant Coils: Coils shall have aluminum fins with copper tubes mechanically expanded for a permanent bond. Coils shall be proof tested at 715 psig and leak tested at 650 psig air-under-water. Coils shall be dehydrated and sealed with a dry air charge. Maximum standard operating conditions are 650 psig at 127 degrees F with refrigerant. Coils shall be rated in accordance with ARI Standard 410.
1. Refrigerant must match the outdoor condensing unit.
2. Refrigerant shall conform to Division 23 Section "Refrigerant Piping."
3. Submit calculations to demonstrate conformance to ASHRAE limits on concentration of refrigerant in indoor spaces. Include the charge in this unit, indoor and outdoor piping, and condensing unit.
4. Provide refrigerant sensor(s) where required by applicable Codes and regulations.

F. Fan assembly: Fan shall be forward curved, centrifugal blower type equipped with direct drive. The fan shaft shall be supported by heavy-duty, permanently sealed ball bearings. The fan shall be dynamically balanced. The fan shall be installed allowing complete service access to the fans and motors.

G. Motors: Electronically commutated open drip-proof with permanently sealed ball bearings, internal current and thermal overload protection, a minimum 1.15 service factor, and resilient base. Motor shall be factory-installed and wired to the unit junction box.

H. Drain pan: The drain pan shall be noncorrosive stainless steel and double-sloped to allow condensate drainage. Coils shall mount above the drain pan, not in the drain pan, allowing the drain pan to be fully inspected and cleaned. The main drain connection shall be at the lowest point of the drain pan. An auxiliary drain connection shall be provided on the same side as the main connection.

I. Filters: Filters shall be 2 inch MERV 13 pleated throwaway type and shall be positioned to filter air before the coils. Refer to Division 23 Section "Particulate Air Filtration."

J. Accessories: Furnish piping accessories as indicated on the Drawings and as required, including but not limited to: Liquid-line solenoid valve, thermal expansion valve, moisture-indicating sight glasses, filters and driers, service shutoff valves, and Schraeder access ports for charging and testing.

2.3 CABINET UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Sterling Hydronics – a division of Mestek, Inc.
2. Beacon-Morris.
3. Modine.
4. Trane.
5. Zehnder Rittling.

B. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 100 psi and 220 degrees F.

C. Cabinet: 0.0598 inch (1.5 mm) steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation [and integral air outlet] [and integral air outlet and inlet grilles].

D. Finish: Factory applied baked enamel of color as selected by the Architect on visible surfaces of enclosure or cabinet.

E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

F. Motor: Tap wound multiple speed permanent split capacitor or shaded pole with sleeve bearings, resiliently mounted.

G. Control: Multiple speed switch, factory wired, located in cabinet.

H. Filter: Easily removed 1 inch thick washable aluminum or glass fiber throw-away type, located to filter air before coil.

2.4 WALL AND KICKSPACE HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Beacon-Morris.
2. Smith's Environmental Products.

B. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 100 psi and 210 degrees F.

C. Cabinet: Galvanized steel inner cabinet.
1. Wall Heaters: Steel outer surface-mounted cabinet with sloped top, exposed corners and edges rounded, tamper-resistant access door, and integral air outlet and inlet grilles.
2. Kickspace Heaters: Steel front panel with integral air outlet and inlet grilles.

D. Finish: Factory applied baked enamel of manufacturer's standard color on visible surfaces of enclosure or cabinet.

E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

F. Motor: Dual-speed permanent split capacitor or shaded pole with sleeve bearings, resiliently mounted.

G. Control: Dual-speed switch, factory wired, located in wall cabinet behind tamper-resistant access door, or in front face of kickspace heater. Aquastat with fixed 120°F setpoint to enable fan.
1. Kickspace Heaters: Provide switch guard to prevent unintended changing of switch position, such as contact with shoes or brooms.

H. Filter: None required.

2.5 FINNED TUBE RADIATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Sterling Hydronics – a division of Mestek, Inc.
2. Slant-Fin.
3. Vulcan Radiator – a division of Mestek, Inc.
4. Zehnder Rittling.

B. Heating Elements: Seamless copper tubing, mechanically expanded into evenly spaced aluminum fins and suitable for soldered fittings.

C. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

D. Enclosures: Steel of thickness indicated on Drawings, with easily jointed components. Support rigidly from building structure, on ceiling mounted brackets spaced 3 feet on center maximum.

E. Finish: Factory applied baked enamel of color as selected by the Architect on visible surfaces of enclosure.

F. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 6 x 7 inch minimum size, integral with cabinet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.

C. Protection: Provide finished cabinet units with protective covers during balance of construction.

D. Baseboard Radiation: Locate on outside walls and run cover continuously wall-to-wall unless otherwise indicated. Where drawings show elements located under windows, install with elements centered under windows. Install end caps where units butt against walls.

E. Finned Tube Radiation: Locate where indicated and run cover end-to-end. Where drawings show elements located at ceilings, provide supplemental support materials as necessary.

F. Blower Coils: Locate as indicated, provide vibration isolators, level and shim units, and anchor to structure.

G. Cabinet Unit Heaters, Wall Heaters, and Kickspace Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units. Set speed switch in desired position to achieve scheduled heat output. Guard kickspace heater controls from unintended contact.

H. Hydronic Units: Provide with shut-off valve on supply and lockshield balancing valve on return piping. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing.

I. Units with Cooling Coils: Connect drain pan to condensate drain.

3.2 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filters in blower coils.

END OF SECTION 238200

SECTION 238216 - AIR COILS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water Coils.

1.2 REFERENCES

A. ANSI/ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

B. ANSI/NFPA 70 - National Electrical Code.

C. SMACNA - HVAC Duct Construction Standards, Metal and Flexible (HVACDCS).

D. ANSI/UL 1995 - Heating and Cooling Equipment.

1.3 SUBMITTALS

A. Submit under provisions of Division 01 Section “Submittals”. Indicate coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

B. Submit manufacturer's installation instructions under provisions of Division 01 Section “Submittal Procedures”.

C. Submit manufacturer's certificate, under provisions of Division 01 Section “Quality Requirements”, that coils are tested and rated in accordance with ANSI/ARI 410.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.

D. Protect coils from entry of dirt and debris with pipe caps or plugs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hydronic Coils:
1. Equipment manufacturer.
2. Aerofin Corporation.
3. Capital Coil & Air.
4. Coil Company, LLC.
5. Daikin.
6. Enviro-Tec.
7. Heatcraft.
8. Modine.
9. Super Radiator Coils.
10. Trane.
11. USA Coil.

2.2 FABRICATION - HYDRONIC COILS

A. Fins: Aluminum continuous plate type with full fin collars or individual helical finned tube type wound under tension.

B. Casing: Die formed channel frame of 16 ga galvanized steel with 3/8 inch mounting holes on 6 inch centers. Provide tube supports for coils longer than 36 inches.

2.3 WATER HEATING COILS

A. Headers: Cast iron with tubes expanded into header, seamless copper tube with silver brazed joints, or prime coated steel pipe with brazed joints.

B. Tubes: 5/8 inch OD seamless copper arranged in parallel or staggered pattern, expanded into fins, brazed joints.

C. Testing: Air test under water to 300 psig for working pressure of 200 psig and 220 degrees F.

D. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that mounting locations enable suitable service access for the Owner’s maintenance, and enable future coil removal and replacement.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with air filters mounted upstream of coil and downstream of any entering airstream, so that no unfiltered air reaches the coil.

C. Install in ducts and casings in accordance with SMACNA HVACDCS. Provide removable flanged duct fittings or equivalent to enable coil removal and replacement. Provide duct access doors for cleaning on the upstream side of coils.

D. Support coil sections independent of piping on steel channel or double angle frames and secure to casings.

E. Provide airtight seal between coil and duct or casing.

F. Protect coils to prevent damage to fins and flanges. Comb out bent fins.

G. Install coils level. Install cleanable-tube coils with 1:50 pitch.

H. Make connections to coils with unions and flanges.

I. Locate water supply at bottom of supply header and return water connection at top. Provide manual air vents at high points complete with stop valve. Ensure water coils are drainable and provide drain connection at low points.

J. On water heating coils, connect water supply to leaving air side of coil (counterflow arrangement).

K. Insulate headers located outside air flow as specified for piping.

END OF SECTION 238216

SECTION 238414 – STEAM HUMIDIFIERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrode steam humidifiers.

1.2 RELATED SECTIONS

A. Division 22 Section “Plumbing Piping Insulation.”

B. Division 23 Sections “HVAC Equipment Insulation” and “HVAC Piping Insulation.”

C. Division 23 Section “Instrumentation and Control for Mechanical Systems”: Humidistats and remote shutdown.

D. Division 23 Section “Air Duct Accessories” for drip pans and drip receivers.

E. Division 26: Electrical characteristics and wiring connections.

1.3 REFERENCES

A. ARI 610 - Central System Humidifiers.

B. ARI 630 - Selection, Installation and Servicing of Humidifiers.

C. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Division 01 Section “Submittal Procedures.”

B. Product Data: Provide catalog data indicating rated capacity, dimensions, duct and service connections, electric nameplate data and wiring diagrams.

C. Shop Drawings: Indicate layout of system and components.

1.5 SUBMITTALS FOR INFORMATION

A. Division 01 Section “Submittal Procedures.”

B. Manufacturer's Instructions: Indicate installation instructions and recommendations.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

A. Division 01 Section “Closeout Procedures”: Procedures for submittals.

B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing. Submit

under provisions of Division 01 Section “Operation and Maintenance Data.”

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

1.8 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., or other testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.9 WARRANTY

A. Division 01 Section “Closeout Procedures.”

B. Provide 2 year manufacturer warranty for humidifier unit except the cylinder.

1.10 EXTRA MATERIALS

A. Division 01 Section “Closeout Procedures.”

B. Electrode Humidifiers: Provide 2 humidifier cylinders for each humidifier.

PART 2 - PRODUCTS

2.1 ELECTRODE STEAM HUMIDIFIERS

A. Manufacturers:
1. Dri-Steem Corp.
2. Armstrong International Inc.
3. Nortec.
4. Pure Humidifier Co.
5. No substitutions.

B. Humidifier: ARI 610 self-contained, disposable cylinder, microprocessor-controlled electrode steam generating unit.

C. Performance: As scheduled on the Drawings.

D. Cylinders: Disposable, polypropylene plastic with field adjustable stainless steel electrodes.

E. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing. Incorporate water fill with 1 inch air gap and integral air gap on drain. Fill solenoid valve shall incorporate built-in strainer, pressure reducing and flow regulating orifice.

F. Cabinet: Steel, 0.058 inches with enamel finish, with hinged and lockable access door.

G. Electric Service: Unit protected by internal fusing on line voltage leads and automatic emergency drain trigger. Incorporate electrical terminals for installation of humidistat, duct high-limit humidistat, interlock to fan or air flow switch.

H. Control:
1. Fully modulating control to provide gradual 0 to 100 percent capacity, with PID tuning. Maximum capacity shall be field adjustable for 0 to 100 percent. High water probe shall prevent overfilling.
2. Touchscreen color display with menus, icons, and graphics for programming and troubleshooting. USB port for downloading and backing-up data, and for firmware updates. Passcode protected security levels. Test outputs with countdown timers. Real-time clock for time-stamping of alarm messages. Data logging, programmable outputs, and cycle counter. BACnet and Modbus protocols for interface to building control system. Web interface for monitoring over an Ethernet connection.

I. Drain Cycle: Automatic drain and fill events for optimized performance based on water type. Field adjustable, automatically cycled based on water conductivity, with automatic drain valve. Automatic fill valve cycles to maintain electric current flow proportional to the humidification output demand signal.

J. Steam Distributor: Stainless steel steam dispersion tube suitable for insertion in duct with condensate separator and return leg to remove condensate from distributor and return to humidifier fill. Steam hose from generator to dispersion tube shall be 1-1/2 inch diameter reinforced rubber.

K. Display: Digital, providing select monitoring of unit amperage draw, percentage demand from humidistat, steam output, and manually set capacity adjustment. Lamps to indicate full cylinder.

L. High-Limit Humidistat: Duct mounted, solid state electronic sensor, 24 volt.

M. Airflow-Proving Switch: Duct mounted, 24 volt.

N. Electrical Characteristics:
1. As scheduled on the Drawings.
2. Refer to Division 26.
3. Disconnect Switch: Factory mount disconnect switch in control panel.

2.2 DRAIN COOLER

A. Manufacturers:
1. Dri-Steem Corp.
2. Condair.
3. Neptronic.
4. Nortec.
5. Pure Humidifier Co.

B. Drain Cooler: Mixing chamber of 300-series stainless steel with wall-mounting bracket, pipe

fittings, and thermowell. Vacuum breaker with brass body. Mechanically-activated non-electric bronze-body domestic water control valve. Temperature sensor inserted in thermowell, with interconnecting capillary control tubing to valve actuator.

C. Ratings: Hot water inflow up to 212 deg. F. Domestic cold water inflow up to 70 deg. F, at a range including 35 to 80 psig. Tempered water outflow controlled to 140 deg. F maximum, with hot water inflow rate greater than or equal to the maximum humidifier drain flow rate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with ARI 630.

C. Provide galvanized steel rods to support distribution manifolds and mount in air system plenums.

D. Pipe domestic water supply and drain outlet with copper piping and unions. Provide shutoff ball valve and strainer in water supply piping. Provide a water hammer arrestor, with shutoff ball valve.

E. Mount drain cooler to wall, with supplemental blocking or backboard as necessary. Pipe to humidifier drain outlet, domestic water supply, and indirect waste receiver, with copper piping and unions. Provide shutoff ball valve and strainer in water supply piping.

F. Insulate steam distribution piping and its return drain piping, domestic water piping, humidifier drain piping, and drain-cooler discharge piping, and the drain cooler body. See Division 22 Section “Plumbing Piping Insulation” and Division 23 Sections “HVAC Equipment Insulation” and “HVAC Piping Insulation” for insulation and protective jacketing. Verify insulation recommendations with humidifier and drain cooler manufacturers, and obtain approval from Owner’s construction manager before installing insulation.

G. Provide airflow proving switch and high-limit humidistat inserted into ductwork. Install and wire to prevent improper humidifier operation.

H. Coordinate controls with Division 23 of the Specifications.

END OF SECTION 238414

SECTION 238416 - INDOOR, MECHANICAL DEHUMIDIFICATION UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes packaged, factory-assembled and -tested, refrigerant-type, indoor, mechanical dehumidification units designed for indoor installation.

1.2 RELATED SECTIONS

A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”

B. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

C. Division 23 Section “Identification for HVAC Piping and Equipment.”

D. Division 23 Section “Instrumentation and Control for Mechanical Systems.”

E. Division 23 Section “Metal Ducts.”

F. Division 23 Section “Air Duct Accessories.”

G. Division 26 “Electrical” - Equipment Wiring Systems: Electrical characteristics and wiring connections. Electrical supply to units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of indoor, mechanical dehumidification unit.

B. Shop Drawings: For each indoor, mechanical dehumidification unit.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality-control reports.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

PART 2 - PRODUCTS

2.1 INDOOR, MECHANICAL DEHUMIDIFICATION UNIT MANUFACTURERS

A. Manufacturers:

1. Munters.
2. Bry-Air.

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. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. ASHRAE 62.1 Compliance: Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-up."

D. ASHRAE 15 Compliance: "Safety Standard for Refrigeration Systems."

2.3 GENERAL

A. Ship unit as a single unitized package, functionally tested at the manufacturer’s factory, with the components necessary to maintain normal operation.

B. Single-point power connection to power the entire unit.

2.4 CASINGS

A. Casing: Single-wall construction with exterior powder-coated galvanneal steel or aluminum, stainless-steel or galvanized fasteners, knockouts for electrical and piping connections, and hanger connection points.

1. Access: Removable panels or hinged access doors with hex-head fasteners or cam latches. Access to desiccant wheel must allow inspection and servicing without disconnecting ductwork or electrical wiring.
2. Insulation: On surfaces of internal process airflow and reactivation airflow components.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
4. Process Air Inlet: Screened to allow intaking air from surrounding room.

2.5 DESICCANT WHEEL

A. Non-cycling sorption type with a single desiccant rotary structure. Unitized welded aluminum casing. Fabricated glass-reinforced extended desiccant surface of inert silicates, smooth and continuous in the airflow direction, not subject to damage from temperature and moisture cycling. Water washable, non-toxic, compliant with NFPA 255 and ASTM E84.

B. Full-contact pressure seals to separate the process and reactivation airstreams, eliminating leakage of air and moisture at static pressure differential up to 3 in. wg.

C. Drive motor and non-ratcheting belt drive, with automatic belt tensioner.

2.6 REACTIVATION HEATER

A. Electric heating coil, with solid-state energy modulation to optimize desiccant media reactivation. Independent reactivation-fan and high-temperature protection, including a downstream temperature switch which stops the dehumidifier and activates the Fault light, requiring manual reset. Fusible-link protection for each heating element.

2.7 FANS

A. Process and Reactivation Fans: Centrifugal, galvanized or stainless steel or aluminum, with direct drive, and safety guards. Airflow and external static pressure as scheduled on the Drawings to enable operation with the indicated ductwork.

B. Fan Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment." Automatic-reset thermal overloads to protect each motor independently.

C. Balancing Dampers: Provide as necessary to ensure that process and reactivation airflows meet the manufacturer’s requirements. Coordinate with Division 23 Section “Air Duct Accessories.”

2.8 FILTERS

A. Filter Media: Washable metal, or pleated media, as manufacturer’s standard.

2.9 CONTROLS

A. Control Panel: Integral service compartment containing fan-motor thermal and overload cutouts, control transformer, and fan and wheel motor contactors or equivalent. Provide on the exterior of the unit a running light, fault light, time meter, and nonfused factory-mounted and -wired auto/off/manual control switch. Inside the unit, provide a circuit breaker to disconnect power from the internal components and controls.

B. Operating Controller: Factory-installed microprocessor controller. Installed in the unit control panel or electrical compartment. Include control of the process and reactivation fans, desiccant wheel rotation speed, and electric heater. Automatic restart after power failure. Input for remote room dehumidification demand signal, and output contacts for monitoring run and fault conditions, compatible with the building automatic temperature control system specified in Division 23 Section “Instrumentation and Control for Mechanical Systems.”

1. A temperature sensor in the reactivation air stream downstream of the desiccant wheel cycles the electric heater element. A cool-down cycle controlled by a thermostatic switch maintains reactivation fan operation to cool the electric heater elements

C. Constant Process Blower Operation: Factory programmed and configured to operate the process blower continuously, independent of dehumidification and reactivation. Prepare the unit for its

process air discharge to be ducted to the associated Blower Coil, which fan will also operate continuously.

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 rooms for suitable conditions and mounting facilities where dehumidification units will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:

1. Provide supports and base frames for suspending units from building structural framing. Adjust frame supports to mount the units plumb level. Ensure that supports do not interfere with access to the dehumidifier or other equipment and ductwork.
2. Comply with requirements for vibration isolation devices specified in Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”

3.3 DUCT CONNECTIONS

A. Where piping is installed adjacent to dehumidification units, allow space for service and maintenance of dehumidification units.

B. Connect ductwork to dehumidification units with flexible connectors.

C. Duct installation requirements are specified in Division 23 Section “Metal Ducts.” Drawings indicate the general arrangement of ducts.

D. Provide manual balancing dampers and iris dampers in each airstream and where indicated. Size manual dampers to ensure balancing to the flow rates indicated. Reactivation-air connection shall be open to draw air from the surrounding room.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring according to Division 26 requirements.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between control devices.

C. Connect control wiring according to Division 23 Section “Instrumentation and Control for Mechanical Systems” and Division 26 requirements.

3.6 CLEANING

A. Clean dehumidification units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, desiccant wheels, and cabinets.

B. After completing system installation, testing, and startup service of dehumidification units, clean filter housings and filters. If filters are disposable type, provide new filters and furnish a spare set to the Owner.

3.7 ADJUSTING

A. Adjust initial temperature and humidity set points.

3.8 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.

B. Starting procedures for dehumidification units include the following:

1. Energize motors; verify proper operation of motors, drive systems, and fan and desiccant wheels. Adjust fans to required airflows. Replace malfunctioning components.
2. Measure and record motor's electrical values for voltage and amperage.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for Mechanical Systems" for testing, adjusting, and balancing of dehumidification unit.

D. Startup Report: Report findings during startup. Identify startup steps, corrective measures taken, and final results.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain dehumidification units.

END OF SECTION 238416

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 Division 26.

1.2 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 Owner no fewer than fourteen 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. Emergency lighting.
   b. Elevators.
   c. Fire-alarm systems.

4. Arrange to provide temporary emergency and standby electrical service or power so facility may remain occupied during the outage in accordance with requirements specified in Section 015000 "Temporary Facilities and Controls." Coordinate power requirements with Owner.

1.3 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. Electrical raceway installation plan

1.4 ACTION SUBMITTALS

A. Comprehensive coordination and integration of submittals between trades is required and must be completed. The Contractor will be responsible for all schedule delays and cost impacts

resulting from changes and conflicts which have not been fully coordinated as part of the buy-out and shop drawing preparation.

B. The Contractor, before transmittal of the Coordination Drawings to the Owner for approval, shall review with and obtain sign-off from the subcontractors indicating that the work of their trade is fully coordinated.

C. Coordination Drawings for Ceiling Areas: 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 conduit.
8. Elevation and size of wall-mounted and ceiling-mounted equipment.
9. Access panels.
10. Sprinklers.
11. Air inlets and outlets.
12. Control modules.
13. Luminaires.

D. Coordination Drawings for Conduit Routing: Conduit 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.

E. Conduit Layout Drawing: Show conduit routing for all systems (electrical, fire alarm, controls, security, etc.) on a plan. Identify any steel penetrations (as allowed in the contract documents) on this drawing. Sizes of conduit shall be color coded and identified for each system. The Contractor is responsible for ensuring conduit is provided for all circuits/infrastructure as shown on the one-line diagrams, schematics including any circuits required for Contractor-selected equipment, RFI responses, ASI's, and Contractors means and methods.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. 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.
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.

B. 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 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.

C. Software:

1. Program Software Backup: Provide USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
2. Provide to Owner upgrades and unrestricted licenses for installed and backup software, including operating systems and programming tools required for operation and maintenance.

PART 2 - PRODUCTS

2.1 Not used.

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.

END OF SECTION 260010

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.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Connectors and splices.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

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. Alpha Wire; brand of Belden, Inc.
2. Encore Wire Corporation.
3. Southwire Company, LLC.

B. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

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 THHN and Type THWN-2. Comply with UL 83.
2. Type XHHW-2. Comply with UL 44.

2.2 NONMETALLIC UNDERGROUND CONDUIT WITH CONDUCTORS, TYPE NUCC

A. Description: A factory assembly of conductors or cables inside a nonmetallic, smooth wall raceway with a circular cross section.

B. Applicable Standards:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

a. Reference Standards: UL 1990.

2.3 METAL-CLAD CABLE, TYPE MC

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. AFC Cable Systems; Atkore International.
2. Encore Wire Corporation.
3. Southwire Company, LLC.

B. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

C. Standards:

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.

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 or Aluminum, interlocked.

2.4 CONNECTORS AND SPLICES

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 Electrical Products.
2. Ideal Industries, Inc.
3. TE Connectivity Ltd.

B. 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.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: Two hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders and Branch Circuits:

1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type XHHW-2, single conductors in raceway.

A. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

B. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits 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. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 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.

3.5 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.

3.6 FIRESTOPPING

A. Apply 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."

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

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.

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 260519

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.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. 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."

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. 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. Source Limitations: Obtain products from single manufacturer.

C. 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.

D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp:

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.
c. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.

2. General Characteristics:

a. Two pieces with zinc-plated bolts.
b. Clamp Material: Silicon bronze.
c. Listed for outdoor use.

E. UL KDER - Beam Grounding and Bonding Clamp:

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. Panduit Corp.

2. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.

2.3 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Source Limitations: Obtain products from single manufacturer.

C. 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.

D. UL KDER - Bonding Bushing:

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. Crouse-Hinds; brand of Eaton, Electrical Sector.

2. General Characteristics: Threaded bushing with insulated throat.

E. UL KDER - Grounding Bushing:

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. Crouse-Hinds; brand of Eaton, Electrical Sector.

2. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.4 GROUNDING AND BONDING HUBS

A. Description: Hubs with certified grounding or bonding locknut.

B. Source Limitations: Obtain products from single manufacturer.

C. 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.

D. UL KDER - Grounding and Bonding Hub:

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. Crouse-Hinds; brand of Eaton, Electrical Sector.

2. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

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.

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.
2. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.

3. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.
4. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

3.3 INSTALLATION OF GROUNDING AND BONDING

A. Comply with manufacturer's published instructions.

B. 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.

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.

g. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL FOR GROUNDING AND BONDING

A. Field tests and inspections must be witnessed by Architect.

B. 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.

C. 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.

D. Collect, assemble, and submit test and inspection reports.

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 Owner.

END OF SECTION 260526

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. 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. Fasteners.
f. Anchors.
g. Saddles.
h. Brackets.

B. Delegated Design Submittals: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

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. Allied Tube & Conduit; Atkore International.
b. Unistrut; Atkore International.

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.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, 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:

1) Hilti, Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless 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:

1) Hilti, Inc.

3. 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.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
6. Toggle Bolts: Stainless steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

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

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."

D. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

G. 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. 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. 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 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

3.4 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.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S duct raceways.
4. Type LFMC duct raceways.
5. Type PVC duct raceways and fittings.
6. Fittings for conduit, tubing, and cable.
7. Electrically conductive corrosion-resistant compounds for threaded conduit.
8. Solvent cements.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

1.2 DEFINITIONS

A. Conduit: A structure containing one or more duct raceways.

B. Duct Raceway: A single enclosed raceway for conductors or cable.

C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.3 ACTION SUBMITTALS

A. Product Data:
1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S duct raceways.
4. Type LFMC duct raceways.
5. Type PVC duct raceways and fittings.
6. Fittings for conduit, tubing, and cable.
7. Electrically conductive corrosion-resistant compounds for threaded conduit.
8. Solvent cements.

PART 2 - PRODUCTS

2.1 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

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 FJMX; including UL 797.

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 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. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
    c. Wheatland Tube; Zekelman Industries.

2. Material: Steel.
3. Options:

    a. Exterior Coating: Zinc.
    b. Interior Coating: Zinc with organic top coating.
    c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.2 TYPE ERMC-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

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 DYIX; including UL 6.

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 DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-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. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
    c. Wheatland Tube; Zekelman Industries.
2. Exterior Coating: Zinc.
3. Options:
    a. Interior Coating: Zinc with organic top coating.
    b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.3 TYPE FMC-S AND TYPE FMC-A DUCT RACEWAYS

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 DXUZ; including UL 1.

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 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. Allied Tube & Conduit; Atkore International.
    b. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
    c. Wheatland Tube; Zekelman Industries.
2. Material: Steel.
3. Options:

a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.4 TYPE LFMC DUCT RACEWAYS

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 DXHR; including UL 360.

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 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. Electri-Flex Company.
b. International Metal Hose Co.

2. Material: Steel.
3. Options:

a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.5 TYPE PVC DUCT RACEWAYS AND FITTINGS

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 DZYR; including UL 651.

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 DZYR - 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.
2. Dimensional Specifications: Schedule 40.
3. Options:

   a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
   b. Markings: For use with maximum 90 deg C wire.

2.6 FITTINGS FOR CONDUIT, TUBING, AND CABLE

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.

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 DWTT - Fittings for Type ERMC, Type PVC, Type EPEC:

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. Crouse-Hinds; brand of Eaton, Electrical Sector.
   b. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Listing Criteria: UL CCN DWTT; including UL 514B.
3. Options:

   a. Material: Steel.
   b. Coupling Method: Compression coupling .
   c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

D. 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. Crouse-Hinds; brand of Eaton, Electrical Sector.
    b. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Listing Criteria: UL CCN FKAV; including UL 514B.
3. Options:

    a. Material: Steel.
    b. Coupling Method: Compression coupling or Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
    c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

E. 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. Crouse-Hinds; brand of Eaton, Electrical Sector.
    b. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Listing Criteria: UL CCN ILNR; including UL 514B.

F. UL DXAS - Fittings for Type LFMC and Type LFNC 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. Crouse-Hinds; brand of Eaton, Electrical Sector.
    b. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Listing Criteria: UL CCN DXAS; including UL 514B.

2.7 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

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 FOIZ; including UL Subject 2419.

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 FOIZ - Electrically Conductive Corrosion-Resistant Compound for Threaded Conduit:

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.

2.8 SOLVENT CEMENTS

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 DWTT; including UL 514B.

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 DWTT - Solvent Cements for Type PVC Duct Raceways 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.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.

B. Outdoors:

1. Exposed and Subject to Severe Physical Damage: ERMC.
2. Exposed and Subject to Physical Damage: ERMC.

    a. Locations less than 2.5 m (8 ft) above finished floor.

3. Exposed and Not Subject to Physical Damage: Corrosion-resistant EMT.
4. Concealed Aboveground: EMT.
5. Direct Buried: PVC-40.
6. Concrete Encased Not in Trench: PVC-40.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

C. Indoors:

1. Exposed and Subject to Severe Physical Damage: ERMC. Locations include the following:

    a. Elevator pits.

2. Exposed and Subject to Physical Damage: ERMC. Locations include the following:

    a. Locations less than 2.5 m (8 ft) above finished floor.
    b. Stub-ups to above suspended ceilings.

3. Exposed and Not Subject to Physical Damage: EMT.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: Corrosion-resistant EMT.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC and IMC: 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 Contract Documents or manufacturers' published instructions, comply with the following:
   1. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
   2. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
   3. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
   4. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
   5. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
   6. Expansion Fittings: NEMA FB 2.40.
   7. 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. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
      c. 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.
      d. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
      e. Support conduit within 12 inch of enclosures to which attached.
      f. 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.
      g. 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) Where otherwise required by NFPA 70.

      h. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
      i. 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.
      j. 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.
      k. 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.

l. 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.

m. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric 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 ERMC and IMC:

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, and LFNC:

a. Provide a maximum of 36 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, HDPE, and EPEC:

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.

5. Stub-ups to Above Recessed Ceilings:

a. Provide EMT, IMC, or ERMC 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 Raceway Terminations at Locations Subject to Moisture or Vibration:

a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.

7. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

a. EMT: Provide setscrew orcompression, steel 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.

8. Expansion-Joint Fittings:

a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERMC 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.
b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:

1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
2) Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
3) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
4) Attics: 135 deg F temperature change.

c. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
d. Install expansion fittings at locations where conduits cross building or structure expansion joints.
e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

9. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.
10. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.

a. Provide warning signs.

D. Interfaces with Other Work:
1. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 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 260533.13

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. 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.

B. Shop Drawings:

1. Shop drawings for floor boxes.

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. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    b. Pass & Seymour; Legrand North America, LLC.
    c. Wiremold; Legrand North America, LLC.
3. Options:

    a. Material: Sheet steel.
    b. Sheet Metal Depth: Minimum 1.5 inch.

D. 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. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    b. Pass & Seymour; Legrand North America, LLC.
    c. Wiremold; Legrand North America, LLC.
3. Options:

    a. Material: Sheet steel.
    b. Sheet Metal Depth: minimum 1.5 inch.

E. 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. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

F. UL QCIT - Metallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

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. Leviton Manufacturing Co., Inc.
b. Wiremold; Legrand North America, LLC.

3. Options:
a. Provide cover and finish coordinated with the Architect.
1) Cover must be aluminum with hinged box access.
b. Provide a four gang box with devices and blank plates.
c. Provide the box with two (2) independent wiring compartments that allow capacity for up to two (2) duplex receptacles, communication, and audio/video services.
d. The box shall be fully adjustable, providing a maximum of 1-3/8-inch pre-pour adjustment, and a maximum of 3/4-inch after-pour adjustment. Provide box with two (2) blank device plates to seal off wire and cable routing passageways.

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. Hoffman; brand of nVent Electrical plc.
b. Milbank Manufacturing Company.
c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

3. Options:

a. Degree of Protection: Type 1.

D. 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. Hoffman; brand of nVent Electrical plc.
b. Milbank Manufacturing Company.

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. Crouse-Hinds; brand of Eaton, Electrical Sector.
b. Leviton Manufacturing Co., Inc.
c. 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: 0.040 inch thick aluminum, anodized or lacquered to prevent corrosion.

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. Crouse-Hinds; brand of Eaton, Electrical Sector.
b. Leviton Manufacturing Co., Inc.
c. 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: White.

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.

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. Leviton Manufacturing Co., Inc.
b. 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 Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:

a. Type 3R unless otherwise indicated.

2. Indoors:

a. Type 1 unless otherwise indicated.
b. Damp or Dusty Locations: Type 1200000.

C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
1. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

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 Architect 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 center 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 install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
11. 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.
12. 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.

13. 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.

D. Interfaces with Other Work:

1. Coordinate with Section 260573.13 "Short-Circuit Studies" for determining available fault current on input feeder.
2. Coordinate with Section 260573.19 "Arc-Flash Hazard Analysis" for determining arc-flash hazard on input feeder.

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 Owner.

END OF SECTION 260533.16

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Tapes and stencils.
3. Signs.
4. Cable ties.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 LABELS

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 PGDQ2 for components; including UL 969.

B. UL PGDQ2 - 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. Seton Identification Products; a Brady Corporation company.

C. UL PGDQ2 - Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, polyester flexible label with acrylic pressure-sensitive adhesive.

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. Seton Identification Products; a Brady Corporation company.

2. Self-Lamination: Clear; UV-, weather-, and chemical-resistant; self-laminating, with protective shield over legend. Size labels such that clear shield overlaps entire printed legend.
3. Marker for Labels:

a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. UL PGDQ2 - Self-Adhesive Labels: Polyester, 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. Brady Corporation.
b. 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.

2.2 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. Brady Corporation.
b. Champion America.
c. Ideal Industries, Inc.

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. Champion America.

c. Ideal Industries, Inc.

C. Floor Marking Tape: 2 inch wide, 5 mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

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. Ideal Industries, Inc.

D. Underground-Line Warning 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. Brady Corporation.
b. Champion America.
c. Ideal Industries, Inc.

2. Tape:

a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical utility lines.
b. Printing on tape must be permanent and may not be damaged by burial operations.
c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".

4. Detectable Line-Warning Tape:

a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, compounded for direct-burial service.
b. Width: 3 inch.
c. Overall Thickness: 5 mil.
d. Foil Core Thickness: 0.35 mil.
e. Weight: 28 lb/1000 sq. ft.
f. Tensile in accordance with ASTM D882: 70 lbf and 4600 psi.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch.

2.3 SIGNS

A. Baked-Enamel 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. Champion America.
    c. Ideal Industries, Inc.
2. Preprinted aluminum signs,punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4 inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inch.

B. 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. Champion America.
    c. Ideal Industries, Inc.
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.

2.4 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.

B. 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 ZODZ; including UL 1565 or UL 62275.

C. UL ZODZ - 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.

D. UL ZODZ - UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, 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.

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 SELECTION OF COLORS AND IDENTIFICATION MARKINGS

A. Comply with 29 CFR 1910.144 for color identification of hazards, 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.

B. Pipe and Conduit Labeling: Comply with ASME A13.1 and IEEE C2.

C. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

1. Color must be factory applied or field applied for sizes larger than 6 AWG when permitted by authorities having jurisdiction.
2. Colors for 208Y/120 V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 240 V Circuits:

a. Phase A: Black.
b. Phase B: Red.

4. Colors for 480Y/277 V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

5. Color for Neutral (Grounded Conductor): White or gray.
6. Color for Equipment Ground: Bare copper, Green, or Green with yellow stripe.

D. Color-Coding Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.

E. 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. "POWER."

F. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

G. Locations of Underground Lines: Underground-line warning tape for power and lighting.

H. Vaults, Manholes, Handholes, and Pull and Junction Boxes, More Than 1000 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and separate tag with circuit designation.

I. Vaults, Manholes, Handholes, and Pull and Junction Boxes, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound 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.
2. Identify system voltage and system or service type with black letters on orange field.

J. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A: Identify with self-adhesive raceway labels.

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.
2. Identify system voltage and system or service type with black letters on orange field.

K. Cover Plates: Label individual cover plates with self-adhesive labels. Place label at top of cover plate. Label cover plate with the following information, in the order listed:

1. Panelboard designation.
2. Colon or dash.
3. Branch circuit number.

L. Workspace Indication: For panelboards, 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.

M. Equipment Identification Labels:

1. Black letters on white field.
2. Indoor Equipment: Self-adhesive label.
3. Outdoor Equipment: Laminated acrylic or melamine sign.
4. Equipment to Be Labeled:
    a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
    e. Enclosed switches.
    f. Enclosed circuit breakers.
    g. Enclosed controllers.
    h. Variable-speed controllers.

N. 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 SELECTION OF SIGNS AND HAZARD MARKINGS

A. Comply with 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs.

B. 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.

C. Electrical Hazard Warnings:

1. Arc-Flash Hazard Warning: Self-adhesive labels. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash hazard warning labels.
2. Raceways and Cables Carrying Circuits at More Than 1000 V:
    a. Black letters on orange field.
    b. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

3. OSHA Workspace Clearance Warning Legend: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."

D. Operating Instruction Signs: Self-adhesive labels.

3.4 INSTALLATION

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. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

C. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

D. 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.

E. Install identifying devices before installing acoustical ceilings and similar concealment.

F. Verify identity of item before installing identification products.

G. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

H. Apply identification devices to surfaces that require finish after completing finish work.

I. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.

K. 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.

L. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

M. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

N. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

O. 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.

P. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

Q. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.

R. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape not less than 12 inch directly above cables or raceways buried 18 inch or more below grade. Use multiple tapes where width of multiple lines installed in common trenchexceeds 16 inch overall.

S. Metal Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

T. Nonmetallic Preprinted Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

U. Write-on Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

V. Baked-Enamel Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

W. Metal-Backed Butyrate Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

X. Laminated Acrylic or Melamine Plastic Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

END OF SECTION 260553

SECTION 260573.13 - SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, fault-current study to determine minimum interrupting capacity of circuit protective devices.

B. Related Requirements:
1. Section 260573.16 "Coordination Studies" for overcurrent protective device coordination studies.
2. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash studies.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items must remain functional throughout construction period.

B. 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.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

F. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Short-Circuit Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form.

a. Short-circuit study input data, including completed computer program input data sheets.
b. 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.
c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. 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. ETAP; brand of Operation Technology, Inc.; subsidiary of Schneider Electric.
2. EasyPower; brand of Bentley Systems, Inc.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of power systems analysis software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output.

E. Computer program must be designed to perform short-circuit studies or have function, component, or add-on module designed to perform short-circuit studies.

F. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 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. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any 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. 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.

F. 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.

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:

    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:

        1) Based on fault-point X/R ratio.
        2) Based on calculated symmetrical value multiplied by 1.6.
        3) 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.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain data necessary for conduct of study.

1. Verify completeness of data supplied on one-line diagram. Call discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers in accordance with NFPA 70E.

B. Gather and tabulate required input data to support short-circuit study. 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 551 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:

1. Product Data for 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.
2. Obtain electrical power utility impedance at service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
6. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
7. Motor horsepower and NEMA MG 1 code letter designation.
8. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
9. Derating factors.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on device characteristics supplied by device manufacturer.

D. Begin short-circuit current 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.

E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. 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.

G. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each 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.

H. Include in report identification of protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260573.16 - COORDINATION STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

B. Related Requirements:
1. Section 260573.13 "Short-Circuit Studies" for fault-current studies.
2. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash studies.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items must remain functional throughout construction period.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when abnormal current flow exists and then removes the affected portion of the circuit from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

F. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Coordination Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form.

a. Coordination-study input data, including completed computer program input data sheets.
b. Study and equipment evaluation reports.
c. 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.
d. Revised one-line diagram, reflecting field investigation results and results of coordination study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. 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. ETAP; brand of Operation Technology, Inc.; subsidiary of Schneider Electric.
2. EasyPower; brand of Bentley Systems, Inc.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program 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.

1. Optional Features:

    a. Arcing faults.
    b. Simultaneous faults.
    c. Explicit negative sequence.
    d. Mutual coupling in zero sequence.

E. Computer program must be designed to perform coordination studies or have function, component, or add-on module designed to perform coordination studies.

F. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 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. Switchgear, switchboard, motor-control center, and panelboard designations.
6. Revisions to electrical equipment required by study.
7. Study Input Data: As described in "Power System Data" Article.

    a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

D. Protective Device Coordination Study:

1. 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.

    a. Phase and Ground Relays:

        1) Device tag.
        2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
        3) Recommendations on improved relaying systems, if applicable.

b. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, and ground).
2) Adjustable time-current characteristic.
3) Adjustable instantaneous pickup.
4) Recommendations on improved trip systems, if applicable.

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.
j. Largest feeder circuit breaker in each motor-control center and panelboard.

5. Maintain selectivity for tripping currents caused by overloads.
6. Provide adequate time margins between device characteristics such that selective operation is achieved.
7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project 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.

1. 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.

3.2 POWER SYSTEM DATA

A. Obtain data necessary for conduct of overcurrent protective device study.

1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers must be in accordance with NFPA 70E.

B. Gather and tabulate required input data to support coordination study. List below is guide. Comply with recommendations in IEEE 551 for amount of detail 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:

1. Product Data for overcurrent protective devices specified in other Sections and 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.
2. Electrical power utility impedance at service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. 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.
9. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
10. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
11. Maximum demands from service meters.
12. Motor horsepower and NEMA MG 1 code letter designation.
13. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
14. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
15. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing 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. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.

3.3 COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. Base study on device characteristics supplied by device manufacturer.

D. 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.

E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. 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 according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings must protect transformers according to IEEE C57.12.00, for fault currents.

G. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

H. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. 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.

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. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each 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.

K. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Include in report identification of protective device applied outside its capacity.

3.4 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 obtained in "Power System Data" Article.
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.

3.5 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.

B. Prepare motor-starting study report, noting light flicker for limits proposed by IEEE 141, and voltage sags so as not to affect operation of other utilization equipment on system supplying motor.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to 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 short-circuit and protective device coordination studies.

C. Testing and adjusting must be by qualified low-voltage electrical testing and inspecting agency.

END OF SECTION 260573.16

SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, arc-flash study to determine arc-flash hazard distance and incident energy to which personnel could be exposed during work on or near electrical equipment.

B. Related Requirements:
1. Section 260573.13 "Short-Circuit Studies" for fault-current studies.
2. Section 260573.16 "Coordination Studies" for overcurrent protective device coordination studies.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. 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.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. p.u.: Per unit. The reference unit, established as a calculating convenience, for expressing all power system electrical parameters on a common reference base.

E. SCCR: Short-circuit current rating.

F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

G. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Study Submittals:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form:

    a. Arc-flash study input data, including completed computer program input data sheets.
    b. 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.
    c. Revised one-line diagram, reflecting field investigation results and results of arc-flash study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 COMPUTER 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. ETAP; brand of Operation Technology, Inc.; subsidiary of Schneider Electric.
2. EasyPower; brand of Bentley Systems, Inc.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer program must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.

E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 ARC-FLASH STUDY REPORT CONTENT

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, 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. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

G. 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.

H. 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.

I. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce 3.5 by 5 inch self-adhesive equipment label for each work location included in analysis.

B. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard analysis:

1. Location 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. Labels must be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. 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.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform Short-Circuit and Protective Device Coordination studies prior to starting Arc-Flash Hazard Analysis.

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

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.

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 medium- and low-voltage equipment locations, except equipment fed from transformers smaller than 75 kVA.

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 take into account 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.

3.3 POWER SYSTEM DATA

A. Obtain data necessary for conduct of arc-flash hazard analysis.

1. Verify completeness of data supplied on one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to amount of detail that is required to be acquired in field. Field data gathering must be under direct supervision and control of engineer in charge of performing study, and must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and 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.
2. Obtain electrical power utility impedance or available short circuit current at service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. 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.
9. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
10. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
11. Motor horsepower and NEMA MG 1 code letter designation.
12. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
13. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.4 LABELING

A. Apply one arc-flash label on front cover and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below must have arc-flash label applied to it:
   1. Medium voltage transformers.
   2. Panelboards.
   3. Safety switches.

C. Note 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.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

END OF SECTION 260573.19

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Daylight-harvesting controls.
   2. Business occupancy and vacancy sensors.

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. DPST: Double pole single throw.

B. N.C.: Normally closed.

C. N.O.: Normally open.

D. PIR: Passive infrared.

E. SPDT: Single pole double throw.

F. SPST: Single pole single throw.

1.3 ACTION SUBMITTALS

A. 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.

B. 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.

C. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's published instructions.

B. 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. Warranty documentation.

B. Software and firmware service agreement.

1.6 QUALIFICATIONS

A. Electrical Power Testing (EPT) Technician III: Possessing active NICET EPT Level III certification. Able to manage switching procedures, conduct tests of complex equipment, analyze test and equipment data, plan a job, and lead a team. Has experience performing NFPA 70B, IEEE, and NETA electrical tests.

B. Electrical Power Testing and Inspecting Agency: Entities possessing active credentials from qualified electrical testing laboratory recognized by authorities having jurisdiction.

1. On-site electrical testing supervisors must possess active NICET EPT Technician III certification.

C. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing and inspecting lighting installations in accordance with applicable IES standards.

1.7 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that installed lighting control devices 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. Warranty must convey to Owner upon acceptance of the Work.

1. Extended-Warranty Period: Five 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 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. Leviton Manufacturing Co., Inc.
b. Lithonia Lighting; Acuity Brands Lighting, 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:

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 integrated 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) Digital signal compatible with power pack.

    e. Sensor Type: Closed loop.
    f. Zone: Single.
    g. Power Pack:

        a) LED status lights to indicate load status.
        b) Plenum rated.

        2) Digital controller capable of accepting four 8PSJ inputs with two outputs rated for 20 A LED load at 120 and 277 V(ac). Sensor has 24 V(dc) Class 2 power source.

            a) With integral current monitoring
            b) Compatible with digital addressable lighting interface.
            c) Plenum rated.

    h. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
    i. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
    j. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
    k. 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.
    l. Test Mode: User selectable, overriding programmed time delay to allow settings check.
    m. Control Load Status: User selectable to confirm that load wiring is correct.
    n. Indicator: Two digital displays to indicate the beginning of on-off cycles.

5. Sequence of Operation: As daylight increases, the lights are dimmed at a predetermined level. As daylight decreases, the lights are turned on at a predetermined level.

    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.

2.3 BUSINESS OCCUPANCY AND VACANCY SENSORS

A. 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-mounted, solid-state indoor occupancy and vacancy sensors.
    b. Separate power pack.
    c. Hardwired or Wireless connection to switch lighting control system.
    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.

5. Operation:
    a. See lighting sequence of operation.

B. Wall-Switch Dual-Technology, Passive-Infrared (PIR) and Ultrasonic, 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. Wall-mounted, solid-state indoor occupancy and vacancy sensors.
b. Integrated power pack.
c. Hardwired or Wireless connection to switch lighting control system.
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 2000 sq. ft when mounted 48 inch above finished floor.

5. Operation:
a. 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.

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:

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. 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 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 circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

3.4 FIELD QUALITY CONTROL

A. Administrant for Lighting 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 must be witnessed by Architect.

C. 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.

D. 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.

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.

3.5 CLOSEOUT ACTIVITIES

A. Demonstration:

1. With assistance from factory-authorized service representatives, demonstrate to Owner's maintenance and clerical personnel 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.

3.6 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.

3. Field Reports for Software and Firmware Upgrades: Prepare and submit report after each update, documenting upgrades installed.

END OF SECTION 260923

SECTION 261200 - MEDIUM-VOLTAGE TRANSFORMERS

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 the following types of transformers with medium-voltage primaries:
   1. Pad-mounted, liquid-filled transformers.

1.3 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

1.4 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.

B. Shop Drawings: Diagram power wiring.

C. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

   1. Underground primary and secondary conduit stub-up location.
   2. Dimensioned concrete base, outline of transformer, and required clearances.
   3. Ground rod and grounding cable locations.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Follow-up service reports.

H. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of transformers and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C2.

E. Comply with ANSI C57.12.10, ANSI C57.12.28, IEEE C57.12.70, and IEEE C57.12.80.

F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store transformers protected from weather and so condensation will not form on or in units. Provide temporary heating according to manufacturer's written instructions.

1.7 PROJECT CONDITIONS

A. Service Conditions: IEEE C37.121, usual service conditions

1.8 COORDINATION

A. Coordinate size and location of concrete bases and existing conduits. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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. Acme Electric Corporation; Power Distribution Products Division.
2. Cooper Industries; Cooper Power Systems Division.
3. Cutler-Hammer.
4. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
5. GE Electrical Distribution & Control.
6. Hammond Manufacturing; Transformer Group.
7. Pioneer Transformers.
8. Siemens Energy & Automation, Inc.
9. Square D; Schneider Electric.

2.2 PAD-MOUNTED, LIQUID-FILLED TRANSFORMERS

A. Description: ANSI C57.12.13, ANSI C57.12.26, IEEE C57.12.00, pad-mounted, 2-winding transformers. Stainless-steel tank base. 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

B. Compartment:
1. Provide Type 1 combination high- and low-voltage compartment, clam shell style, with lockable (having pad-locking provisions) hinged cover and single-point latching. Type 1 is defined by IEEE C57.12.25.
2. High-voltage portion contains: the incoming line, insulated high-voltage load-break connectors, bushing well inserts, two high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed fuses, tap changer handle, connector parking stands with insulated standoff bushings, and ground pad.

C. Transformer rating: see Drawings. Confirm the high voltage rating with Client and Architect prior to ordering equipment.

D. Transformer voltage ratings: see Drawings.

E. Minimum tested percent impedance at 85 degrees C:
1. 2.50 for units rated 75kVA and below
2. 2.87 for units rated 112.5kVA to 300kVA
3. 4.03 for 500kVA rated units
4. 5.32 for units rated 750kVA and above

F. Insulating Liquid: Less flammable, dielectric, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.

G. Provide transformer efficiency calculations utilizing the actual no-load and load loss values obtained during the routine tests performed on the actual transformer(s) prepared for this project. Reference no-load losses (NLL) at 20 degrees C.

H. Basic Impulse Level: 30 kV.

I. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.

J. High-Voltage Switch: 200 A, make-and-latch rating of 10-kA RMS, symmetrical, arranged for loop feed with 3-phase, 2-position, gang-operated, load-break switch that is oil immersed in transformer tank with hook-stick operating handle in primary compartment.

K. Primary Fuses: 150-kV fuse assembly with fuses complying with IEEE C37.47. Rating of current-limiting fuses shall be 50-kA RMS at specified system voltage.
1. Bay-O-Net liquid-immersed fuses in series with liquid-immersed current-limiting fuses. Bay-O-Net fuses shall be externally replaceable without opening transformer tank.

L. High-Voltage Terminations and Equipment: Dead front with universal-type bushing wells for dead-front bushing-well inserts, complying with IEEE 386 and including the following:

1. Bushing-Well Inserts: One for each high-voltage bushing well.
2. Parking Stands: One for each high-voltage bushing well.
3. Portable Insulated Bushings: Arranged for parking insulated, high-voltage, load-break cable terminators; one for each primary feeder conductor terminating at transformer.

M. Low-voltage portion contains: low-voltage bushings with NEMA spade terminals, accessories, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

N. Accessories:

1. Drain Valve: 1 inch, with sampling device.
2. Dial-type thermometer.
3. Liquid-level gage.
4. Pressure-vacuum gage.
5. Pressure Relief Device: Self-sealing with an indicator.
6. Lifting lugs and provisions for jacking under base, with base construction suitable for using rollers or skidding in any direction.
7. An insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.
8. Provide transformer top with an access handhole.
9. kVA rating conspicuously displayed on its enclosure.

2.3 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Perform design and routine tests according to standards specified for components. Conduct transformer tests according to IEEE C57.12.90.

B. Factory Tests: Perform the following factory-certified tests on each transformer:

1. Resistance measurements of all windings on rated-voltage connection and on tap extreme connections.
2. Ratios on rated-voltage connection and on tap extreme connections.
3. Polarity and phase relation on rated-voltage connection.
4. No-load loss at rated voltage on rated-voltage connection.
5. Excitation current at rated voltage on rated-voltage connection.
6. Impedance and load loss at rated current on rated-voltage connection and on tap extreme connections.
7. Applied potential.
8. Induced potential.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.

B. 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 have to cross section barriers to reach load or line lugs.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Provide driven ground rods as specified in Section 260526. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

E. Verify that ground connections are in place and that requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install transformers on concrete bases.

1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit and 4 inches high.
2. Place slab on a 6 inch thick, well-compacted gravel base.
3. Install slab such that top of concrete slab is approximately 4 inches above the finished grade with gradual slope for drainage.
4. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified by Civil engineer.
5. Install epoxy-coated anchor bolts, for supported equipment, that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.3 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

C. Perform the following field tests and inspections and prepare test reports:

1. After installing transformers but before primary is energized, verify that grounding system at substation is tested at specified value or less.
2. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.

4. 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. Test Reports: Prepare written reports to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.

END OF SECTION 261200

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Lighting and appliance branch-circuit panelboards.
   2. Disconnecting and overcurrent protective devices.
   3. Instrumentation.

1.2 DEFINITIONS

A. GFEP: Ground-fault equipment protection.

B. MCCB: Molded-case circuit breaker.

C. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Lighting and appliance branch-circuit panelboards.
   2. Disconnecting and overcurrent protective devices.
   3. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   4. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

   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 time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include Internet link for electronic access to downloadable PDF of coordination curves.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards.

B. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Recommended procedures for installing panelboards.
2. Recommended torque settings for bolted connections on panelboards.
3. Recommended temperature range for energizing panelboards.

C. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:

1. Keys: Two spares for each type of panelboard cabinet lock.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panelboards for installation in accordance with NECA 407.

1.8 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 PANELBOARDS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: UL 50E, Type 1.

2. Height: 7 ft maximum.
3. 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.
4. Finishes:

    a. Panels and Trim: 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: Galvanized steel.

F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.

    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.

4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
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.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

I. 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.

J. 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: 10 percent.

K. 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 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Square D; Schneider Electric USA.

B. Listing Criteria: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Door-in-door construction with concealed hinges; secured with flush or multipoint latch with tumbler lock; keyed alike. Outer door must permit full access to panel interior. Inner door must permit access to breaker operating handles and labeling, but current carrying terminals and bus must remain concealed.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. 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. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
4. Subfeed Circuit Breakers: Vertically mounted.
5. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
d. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
e. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
f. Multipole units enclosed in single housing with single handle or factory assembled to operate as single unit.

2.4 INSTRUMENTATION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Square D; Schneider Electric USA.

B. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; window type; single secondary winding and secondary shorting device. Burden and accuracy must be consistent with connected metering devices.

C. Multifunction Digital-Metering Monitor: Schneider ION6200 PowerLogic 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. Ethernet communication.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

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 NECA 407.

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 NECA 407.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Equipment Mounting:
   a. Attach panelboard to vertical finished or structural surface behind panelboard.
   b. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
3. Mount top of trim 7.5 ft above finished floor unless otherwise indicated.
4. Mount panelboard cabinet plumb and rigid without distortion of box.
5. Install overcurrent protective devices and controllers not already factory installed.

   a. Set field-adjustable, circuit-breaker trip ranges.
   b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.

6. 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.
7. Install filler plates in unused spaces.
8. 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; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

D. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.

E. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.

F. Circuit Directory:

1. 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.

2. 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.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage 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.
3. Test and adjust controls and metering. Replace damaged and malfunctioning controls and equipment.

C. Nonconforming Work:

1. Panelboards will be considered defective if they do 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 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 as specified in Section 260573.16 "Coordination Studies."

END OF SECTION 262416

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches.
2. General-grade duplex straight-blade receptacles.
3. Receptacles with ground-fault protective devices.

1.2 ACTION SUBMITTALS

A. Product Data:

1. General-use switches.
2. General-grade duplex straight-blade receptacles.
3. Receptacles with ground-fault protective devices.

B. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:
1. Duplex straight-blade receptacles.
2. Receptacles with GFCI device.

B. Sample warranties.

1.4 WARRANTY FOR DEVICES

A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: Five years from date of Substantial Completion; full prorated coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

A. GENERAL-USE SWITCHES

B. 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. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    b. Leviton Manufacturing Co., Inc.
    c. 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: White.
    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:

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. Leviton Manufacturing Co., Inc.
    c. 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: White.
   b. Configuration:
      1) Heavy-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.

2.3 RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

A. Commercial-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:

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. Leviton Manufacturing Co., Inc.
   c. 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. Provides continuous ground fault protection, detects and trips on actual ground fault even when self-test is being conducted

   b. Reference Standards: UL CCN KCXS, UL 498, and UL 943.

4. Options:

   a. Device Color: White.
   b. Configuration: Heavy-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 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 SELECTION OF GFCI RECEPTACLES

A. Provide non-feed-through GFCI receptacles.

3.3 INSTALLATION OF SWITCHES

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. Consult Architect for resolution of conflicting requirements.

C. Identification:

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.

3.4 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 Architect for resolution of conflicting requirements.

C. Identification:

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. Coordinate installation of new products with existing conditions.

3.5 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. GFCI receptacles- press the TEST and RESET button and ensure it is operating correctly.
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.

D. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.6 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 Owner.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nonfusible switches.
   2. Shunt trip switches.
   3. Molded-case circuit breakers (MCCBs).
   4. Enclosures.

1.2 DEFINITIONS

A. GFEP: Ground-fault circuit-interrupter for equipment protection.

B. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data:

   1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   2. Enclosure types and details for types other than UL 50E, Type 1.
   3. Current and voltage ratings.
   4. Short-circuit current ratings (interrupting and withstand, as appropriate).
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers.

   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

   1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed enclosed switches and circuit breakers 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 GENERAL REQUIREMENTS

A. Source Limitations: Obtain products from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 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.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 SHUNT TRIP 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. Bussmann; Eaton, Electrical Sector.
2. Littelfuse, Inc.
3. Mersen USA.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200 kA interrupting and short-circuit current rating.

C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600 V(ac), Amperes as indicated; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120 V(ac); obtained from external source with control power source of enough capacity to operate shunt trip, pilot, indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight red ON pilot light.
3. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
4. Three-pole, double-throw, fire-safety and alarm relay; 24 V(dc) coil voltage.
5. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
6. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
7. Form C alarm contacts that change state when switch is tripped.
8. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Square D; Schneider Electric USA.

B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.

C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

D. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers must be 100 percent rated.

E. MCCBs must be equipped with device for locking in isolated position.

F. Lugs must be suitable for 60 deg C rated wire on 125 A circuit breakers and below.

G. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal 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.

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

I. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Alarm Switch: One NO and NC contact that operates only when circuit breaker has tripped.
5. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
6. Electrical Operator: Provide remote control for on, off, and reset operations.
7. Accessory Control Power: ; 120 V(ac).

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: Enclosure must be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1).

C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: Circuit-breaker operating handle must be directly operable through front cover of enclosure (UL 50E Type 1). Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

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.

D. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
4. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
5. Install fuses in fusible devices.

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. 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 unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the 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 following methods:

1) Use 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 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 absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify correct phase barrier installation.
i. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

B. Tests and Inspections for Molded-Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that unit is clean.
e. Operate circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use 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 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 absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with coordination study.

2. Test and adjust controls, remote monitoring, and safeties.

C. Nonconforming Work:

1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.7 PROTECTION

A. After installation, protect enclosed switches and circuit breakers 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 262816

SECTION 262913.03 - MANUAL AND MAGNETIC 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:

1. Manual motor controllers.
2. Enclosures.
3. Accessories.
4. Identification.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. NC: Normally closed.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SCPD: Short-circuit protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 FIELD CONDITIONS

A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.
3. The effect of solar radiation is not significant.

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 use.

B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.

C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.

2.2 MANUAL MOTOR CONTROLLERS

A. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Square D; Schneider Electric USA.

2. Standard: Comply with NEMA ICS 2, general purpose, Class A.
3. Configuration: Nonreversing.
4. Surface mounting.

B. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Square D; Schneider Electric USA.
2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.

2.3 ENCLOSURES

A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.

B. The construction of the enclosures shall comply with NEMA ICS 6.

C. Controllers in hazardous (classified) locations shall comply with UL 1203.

2.4 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.

a. Push Buttons: As indicated in the controller schedule.
b. Pilot Lights: As indicated in the controller schedule.

2.5 IDENTIFICATION

A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

B. Arc-Flash Warning Labels:

1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.

C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

D. 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.

E. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
2. Visual and Mechanical Inspection:

    a. Compare equipment nameplate data with drawings and specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, and grounding.
    d. Verify the unit is clean.
    e. Inspect contactors:

        1) Verify mechanical operation.
        2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.

    f. Motor-Running Protection:

        1) Verify overload element rating is correct for its application.
        2) If motor-running protection is provided by fuses, verify correct fuse rating.

g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with 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 according to manufacturer's published data or NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

3. Electrical Tests:
a. Test motor protection devices according to manufacturer's published data.

b. Perform operational tests by initiating control devices.

C. Motor controller will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262913.03

SECTION 265119 - LED INTERIOR 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. Luminaires
2. Materials.
3. Luminaire support.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

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. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. 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. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Sprinklers.
    c. Access panels.
    d. Lighting control devices

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of luminaire.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:

1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 5 to 104 deg F.

B. Altitude: Sea level to 1000 feet.

2.2 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. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels 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.

C. Recessed luminaires shall comply with NEMA LE 4.

D. California Title 24 compliant.

2.3 LUMINAIRES

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. Cooper Lighting Solutions; Signify North America Corp.
2. Lithonia Lighting; Acuity Brands Lighting, Inc.
3. Philips; Signify North America; Signify Holding.

B. Nominal Operating Voltage: 120 V ac.

C. Lamp:

1. Minimum 500 lm.
2. Minimum allowable efficacy of 80 lm/W.
3. CRI of minimum 80. CCT as indicated.
4. Rated lamp life minimum of 35,000 hours to L70.
5. Dimmable from 100 percent to zero percent of maximum light output.
6. Internal driver.
7. User-Replaceable Lamps:

    a. Bulb shape complying with ANSI C78.79.

D. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear finish.
3. Universal mounting bracket.
4. Integral junction box with conduit fittings.

E. 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.

F. Diffusers and Globes:
1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

G. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.

4. Recessed luminaires shall comply with NEMA LE 4.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are unacceptable.

2.6 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum 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 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
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.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling Mount:

    a. Two 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.
    b. Pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.

2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

3. 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.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. 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. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

END OF SECTION 265119

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency lighting.
2. Exit signs.
3. Materials.
4. Luminaire support components.

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. Correlated Color Temperature (CCT): The absolute temperature, measured in kelvins, of a blackbody whose chromaticity most nearly resembles that of the light source.

B. Color Rendering Index (CRI): Measure of the degree of color shift that objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference source.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Lumen (lm): The SI derived unit of luminous flux equal to the luminous flux emitted within a unit solid angle by a unit point source (1 lm = 1 cd-sr).

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of emergency lighting unit, exit sign, and emergency lighting support.

a. Include data on features, accessories, and finishes.
b. Include physical description of unit and dimensions.
c. Battery and charger for light units.
d. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.

e. Include photometric data and adjustment factors based on laboratory tests by, or under supervision of, qualified luminaire photometric testing laboratory, for each luminaire type.

B. Product Schedule:

1. For emergency lighting units. Use same designations indicated on Drawings.
2. For exit signs. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of luminaire.

B. Product Test Reports: For each luminaire for tests performed by, or under supervision of, qualified luminaire photometric testing laboratory.

C. Sample Warranty: For manufacturer's warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.6 WARRANTY

A. Special Installer Extended Warranty for Emergency and Exit Lighting: Installer warrants that fabricated and installed emergency luminaires and exit signs, including batteries, perform in accordance with specified requirements and agrees to repair or replace components and assemblies that fail to perform as specified within extended warranty period.

1. Extended Warranty Period: Five year(s) from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 and UL 924, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Comply with NFPA 101.

C. Comply with NEMA LE 4 for recessed luminaires.

D. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.

1. Emergency Connection: Operate lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
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. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.

    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 EMERGENCY LIGHTING

A. Remote Emergency Lighting Unit :

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. Dual-Lite; brand of GE Current, a Daintree company; American Industrial Partners (AIP).
    b. Lithonia Lighting; Acuity Brands Lighting, Inc.
    c. Philips; Signify North America; Signify Holding.

2. Options:

    a. Operating at nominal voltage of 9.6 V(dc).
    b. Wall with universal junction box adaptor.
    c. UV stable thermoplastic housing, rated for wet locations.
    d. One LED lamp head.
    e. External emergency power unit.

2.3 EXIT SIGNS

A. General Characteristics: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Sign:

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. Dual-Lite; brand of GE Current, a Daintree company; American Industrial Partners (AIP).
   b. Lithonia Lighting; Acuity Brands Lighting, Inc.
   c. Philips; Signify North America; Signify Holding.

2. Options:

   a. Operating at nominal voltage of 120 V(ac).
   b. Lamps for AC Operation:
      1) LEDs; 50,000 hours minimum rated lamp life.

   c. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
   d. Master/Remote Sign Configurations:

      1) Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in battery for power connection to remote unit.
      2) Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components must be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Housings:

1. Extruded aluminum or thermoplastic housing, see the luminaire schedule.
2. Clear finish.

D. Conduit EMT or FMC, minimum metric designator 21 (trade size 3/4).

2.5 METAL FINISHES

A. 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.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 0.106 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

B. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices must be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

C. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

D. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inch, brace to limit swinging.
2. 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.
3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

E. Ceiling Grid Mounted Luminaires:

1. Secure to outlet box, if provided.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by Architect.

B. Tests and Inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C. Nonconforming Work:

1. Luminaire will be considered defective if it does not pass operation tests and inspections.
2. Remove and replace defective units and retest.

D. Prepare test and inspection reports.

3.5 SYSTEM STARTUP

A. Perform startup service:

1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 PROTECTION

A. Remove and replace luminaires and exit signs that are damaged or caused to be unfit for use by construction activities.

END OF SECTION 265213

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Luminaire types.
2. Materials.
3. Finishes.
4. Luminaire support components.
5. Aluminum poles.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project 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. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

C. Delegated Design Submittals: For luminaire supports.

1. Include design calculations for luminaire supports.

1.4 INFORMATIONAL SUBMITTALS

A. 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.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

D. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

E. Source quality-control reports.

F. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminairesto include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:

1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
2. 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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.8 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.

1.9 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: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 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. Bulb shape complying with ANSI C79.1.

E. CRI of minimum 80. CCT of see Drawings.

F. L70 lamp life of 50,000 hours.

G. Lamps dimmable from 100 percent to 0 percent of maximum light output.

H. Internal driver.

I. Nominal Operating Voltage: 120 V ac.

J. In-line Fusing: On the primary for each luminaire.

K. Source Limitations:

1. Obtain luminaires from single source from a single manufacturer.
2. 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.

2.3 LUMINAIRE TYPES

A. Area and Site:

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. Lithonia Lighting; Acuity Brands Lighting, Inc.
    c. Philips; Signify North America; Signify Holding.
2. Luminaire Shape: Square.
3. Mounting: Pole Building with extruded-aluminum arm.

4. Luminaire-Mounting Height: see Drawings.
5. Distribution: see Drawings.
6. Housings:

    a. Extruded-aluminum housing and heat sink.
    b. Powder-coat finish.

2.4 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. 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. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

E. 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.

F. 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.

G. 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.

2.5 FINISHES

A. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

2.7 ALUMINUM POLES

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. Lithonia Lighting; Acuity Brands Lighting, Inc.
    c. Philips; Signify North America; Signify Holding.

B. Poles: Seamless, extruded structural tube complying with ASTM B221, Alloy 6063-T6, with access handhole in in pole wall.

1. Shape: Square, straight.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

D. Grounding and Bonding Lugs: Bolted 1/2 inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. 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 to substrates to which poles and standards are fastened and may not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

F. Handhole: Oval shaped, with minimum clear opening of 2-1/2-by-5 inch, with cover secured by stainless steel captive screws.

G. Performance Requirements
1. Structural Characteristics: Comply with AASHTO LTS-6-M.
2. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA used in pole selection strength analysis.
3. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless steel fasteners and mounting bolts unless otherwise indicated.

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, roofs, and overhang ceilings 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 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. Install lamps in each luminaire.

C. Fasten luminaire to structural support.

D. 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.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

H. Coordinate layout and installation of luminaires with other construction.

I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533.13 "Conduits 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 260533.13 "Conduits 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 260553 "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 with the assistance of a factory-authorized service representative:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Photoelectric Control Operation: Verify operation of photoelectric controls.

C. Luminaire will be considered defective if it does not pass tests and inspections.

D. 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.

END OF SECTION 265619

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Category 6 twisted pair cable.
   2. Twisted pair cable hardware.
   3. Identification products.

1.2 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. Jack: Also commonly called an "outlet," it is the fixed, female connector.

E. LAN: Local area network.

F. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

G. UTP: Unscreened (unshielded) twisted pair.

1.3 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

   1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
   2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
   3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. Category 6 twisted pair cable.
   2. Twisted pair cable hardware.
   3. Identification products.

B. Shop Drawings:

   1. System Labeling Schedules:
      a. Print and Electronic copy of labeling schedules that are part of cabling and asset identification system of software.

   2. Cabling administration Drawings and printouts.
   3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
      a. Telecommunications pathways.
      b. Telecommunications conductor drop locations.
      c. Typical telecommunications details.

C. Twisted pair cable testing plan.

D. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, installation supervisor, and field inspector.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Connecting Blocks: One of each type.
   2. Cover Plates: One of each type.

3. Jacks: Ten of each type.
4. Plugs: Ten of each type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings by a Level 2 Installer.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated:

a. Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway.

B. 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: 50 or less.

C. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Category 6 Twisted Pair Cable: Four-pair, balanced -twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 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. Belden Inc.
3. CommScope, Inc.

C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP).

F. Cable Rating: Plenum.

G. Jacket: White thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

A. Twisted Pair Cable Hardware: Hardware designed to connect, splice, and terminate 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. Belden Inc.
3. Leviton Manufacturing Co., Inc.

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.

E. Connecting Blocks:
1. 110-style IDC for Category 6.
2. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

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. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
3. Number of Jacks per Field: One for each four-pair cable indicated, plus spares and blank positions adequate to suit specified expansion criteria.

G. Patch Cords: Factory-made, four-pair cables in 48-inch lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

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 twisted pair cable.
2. Standard: Comply with TIA-568-C.2.
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 twisted pair cable.

2. Designed to snap-in to a patch panel or cover plate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

J. Cover Plate:

1. Two port, vertical single gang cover plates designed to mount to single gang wall boxes.
2. Plastic Cover Plate: High-impact plastic. Coordinate color with Section 260533.16 "Boxes and Covers for Electrical Systems."

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

A. Factory test cables on reels according to TIA-568-C.1.

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 WIRING METHODS

A. Routing:

1. Install cables in raceways, except within consoles, cabinets, desks, and counters. Conceal raceway and cables, except in unfinished spaces.

    a. Install plenum cable in environmental air spaces, including plenum ceilings.
    b. Comply with requirements for raceways and boxes specified in Section 260533.13 "Conduits for Electrical Systems"

2. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

A. Comply with Section 260533.13 "Conduits for Electrical Systems"

B. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Consolidation points may be used only for making a direct connection to equipment outlets:

    a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    b. Locate consolidation points for twisted pair cables at least 49 feet from communications equipment room.

7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot-long service loop on each end of cable.

13. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication 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 shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

3.4 FIRESTOPPING

A. Comply with TIA-569-D, Annex A, "Firestopping."

B. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

C. Comply with TIA-607-B and NECA/BICSI-607.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: Class 1.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

D. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by Owner.

B. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for 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 twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

D. Nonconforming Work:

1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. Collect, assemble, and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION 271513

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

Content Requests:

<Double click here to submit questions, comments, or suggested edits to this Section.>

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 scope of work for this project is to modify the existing building fire alarm system to provide interface for the supervision of the new wet and dry pipe sprinkler systems, elevator recall interface, and required smoke and heat detectors for elevator recall. Contractor is responsible for the design and layout of the system to provide code compliant fire alarm, sprinkler, and elevator systems.

1. Existing fire-alarm system to be modified.
2. Addressable fire-alarm system.
3. System smoke detectors.
4. Heat detectors.
5. 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.
2. MUBEC (2018)
3. IBC (2015)
4. NFAP 13
5. NFPA 70
6. NFPA 72

7. NFPA 170
8. NFPA 241
9. ASME A17.1-2013

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FACU: Fire-alarm control unit.

C. 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.

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:

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 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. When new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.5 ACTION SUBMITTALS

A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.

B. 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.

C. 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. Detail assembly and support requirements.
5. Include battery-size calculations.
6. Include input/output matrix.
7. 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.
8. Include performance parameters and installation details for each detector.
9. Provide control wiring diagrams for fire-alarm interface to Elevator Control Equipment.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring **and equipment** required for Elevator Control Function on alarm.
    c. Locate detectors in accordance with manufacturer's written instructions, NFPA 72, and ASME A17.1.
10. 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.

D. Delegated Design Submittal: For notification appliances and smoke and heat 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 smoke and heat detector, ratings of each, addressable output modules for Elevator Control Functions, addressable input modules for elevator shunt trip power, and installation details as needed to comply with listing conditions of device.
2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Qualification Statements: For Installer.

C. Sample Warranty: Submittal must include line-item pricing for replacement parts and labor.

1.7 CLOSEOUT SUBMITTALS

A. 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 submit required documentation and fees to obtain required construction permits:

    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.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On **USB media**.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Smoke Detectors, Heat Detectors: One unit of each type.
2. Detector Bases: One unit of each type.

3. Fuses: **Two** of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

1.9 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 II** technician.
3. Obtain certification by NRTL in accordance with NFPA 72.
4. Licensed or certified by authorities having jurisdiction.

1.10 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 EXISTING FIRE-ALARM SYSTEM TO BE MODIFIED

A. Basis for Pricing: Existing to remain Honeywell XLS140 addressable Fire Alarm Control Unit. Include all programming needed for new system.

B. Description: Existing addressable Fire Alarm Control Unit to remain. Reprogramming is required to reflect additions to fire alarm system Modify existing systems and devices, add smoke detection in elevator lobbies for elevator recall. Install heat detectors within 2 feet of sprinklers located within Elevator Control Spaces, Elevator Pit.

C. Accessories: Fully addressable fire alarm system consisting of audio and visual notification devices, initiating devices, and sprinkler system. System will include new smoke detectors and rate-compensated heat detectors. Heat detectors shall be installed in each elevator lobby and within 2 feet of sprinkler heads. Heat detectors shall be of a lower RTI than the sprinkler heads. Smoke detectors shall be installed in elevator lobbies, within 21 feet from the centerline of the elevator door. A smoke detector and heat detector shall be installed above elevator equipment. . Sprinkler valves, waterflow, and pressure switches shall be monitored using addressable interface modules. Elevator recall and shunt trip functions and shunt trip power supervision shall be by addressable interface modules.

D. Source Limitations for Fire-Alarm System and Components: Components must be compatible with, and operate as extension of, existing system. Provide system manufacturer's certification that components provided have been tested as, and will operate as, a system.

2.2 ADDRESSABLE FIRE-ALARM SYSTEM

A. Description:

1. Noncoded, 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 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:
   1) Heat detectors.
   2) Smoke detectors.
   3) Sprinkler waterflow switch.
   4) Manual Pull Stations.

c. Fire-alarm signal must initiate the following actions:

   1) Continuously operate alarm notification appliances.
   2) Identify alarm and specific initiating device at FACU.
   3) Transmit alarm signal to remote alarm receiving station.
   4) Activate voice/alarm communication system.
   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 for elevator lobby detectors.
   8) Activate elevator power shunt trip for elevator heat detectors.
   9) Activate emergency lighting control.
   10) Record events in system memory.
   11) Record events by system printer.

d. Supervisory signal initiation must be by one or more of the following devices and actions:

   1) Valve supervisory switch.
   2) Elevator shunt-trip power supervision.
   3) Independent fire-detection and -suppression systems.
   4) Zones or individual devices have been disabled.
   5) 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) Voice signal amplifier failure.
11) Hose cabinet door open.

f. System Supervisory Signal Actions:

1) Initiate notification appliances.
2) Identify specific device initiating event at FACU.
3) Record event on system printer.
4) After time delay of **200 seconds**, transmit trouble or supervisory signal to remote alarm receiving station.
5) Transmit system status to building management system.
6) Display system status on graphic annunciator.

2.3 SYSTEM SMOKE DETECTORS

A. Photoelectric Smoke Detectors:

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. Compatible with existing Honeywell International, Inc addressable system.

2. Performance Criteria:

a. Regulatory Requirements:

1) NFPA 72.
2) UL 268.

b. General Characteristics:

1) Detectors must be 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.
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.

2.4 HEAT DETECTORS

A. Rate Compensated-Type Heat Detectors:

1. Products: Subject to compliance with requirements, provide the following:
   a. Heat detector listed for compatibility with addressable interface module.
2. Performance Criteria:

   a. Regulatory Requirements:

      1) NFPA 72.
      2) UL 521.

   b. General Characteristics:

      1) Temperature sensors must be monitored by addressable input modules.

   c. Actuated by rate compensated principal. Coordinate temperature and RTI with fire sprinkler contractor based on sprinkler ratings.
   d. Mounting: Twist-lock base interchangeable with smoke-detector bases.
   e. External 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.

2.5 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

A. Products: Subject to compliance with requirements, provide the following:

1. Compatible with existing Honeywell International, Inc addressable system.

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. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown.

1) Allow control panel to switch relay contacts on command.
2) Have minimum of two normally open and two normally closed contacts available for field wiring.

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 **Construction Manager** no fewer than **seven** days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without **Construction Manager's** written permission.

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 placed in service before other trades have completed cleanup must be replaced.
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. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of building.
2. Connect new equipment to existing monitoring equipment at supervising station.
3. Expand, modify, and supplement existing **control** and **monitoring** equipment as necessary to extend existing **control** and **monitoring** functions to new points. New components must be capable of merging with existing configuration without degrading performance of either system.

C. Firestop: Provide listed firestop system for penetrations of fire and smoke resistance rated walls, ceilings, and other rated assemblies. Match the rating of the firestop system to that of the penetrated barrier. Provide L and T ratings on vertical penetrations.

D. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in normal path of egress within 60 inch (1520 mm) 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 (1060 and 1220 mm) above floor level. Devices must be mounted at same height unless otherwise indicated.

E. Smoke- and Heat-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. Comply with requirements for locations of heat detectors relative to sprinklers for elevator shunt trip.
3. Smooth ceiling spacing must not exceed 30 ft. (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inch (910 mm) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inch (300 mm) from lighting fixture and not directly above pendant mounted or indirect lighting.

F. Do not install smoke detectors prior to final construction clean up unless providing smoke detection during non-work periods. Any smoke detectors installed for protection during construction must be replaced following final clean up.

G. 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 (9100 mm) 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.

H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

I. 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.

J. Audible Alarm-Indicating Devices: Install not less than 6 inch (150 mm) below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.

K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch (150 mm) below ceiling. Install devices at same height unless otherwise indicated.

L. Device Location-Indicating Lights: Locate in public space near device they monitor.

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."

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, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch (13 mm) high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inch (2440 mm) above floor must be installed in EMT.

B. Pathways must be installed in EMT.

C. Exposed EMT must be painted red enamel.

3.7 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch (910 mm) from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
   1. Smoke dampers in air ducts of designated HVAC duct systems.
   2. Alarm-initiating connection to elevator recall system and components.
   3. Alarm-initiating connection to activate emergency lighting control.
   4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   5. Supervisory connections at valve supervisory switches.
   6. Supervisory connections at elevator shunt-trip breaker.
   7. Data communication circuits for connection to building management system.
   8. Data communication circuits for connection to mass notification system.
   9. Supervisory connections at fire-extinguisher locations.

3.8 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications 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. Owner will engage qualified testing agency to administer and perform tests and inspections.
   2. Engage qualified testing agency to administer and perform tests and inspections.
   3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
   4. Administer and perform tests and inspections.

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.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.12 MAINTENANCE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.13 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 284621.11

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping, or sealing site utilities.
7. Temporary erosion and sedimentation control.

1.2 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.

1.3 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.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises as directed by owner.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

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.

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. Arrange with utility companies to shut off indicated utilities.

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 two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

C. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
2. Use only hand methods or air spade for grubbing within protection zones.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

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 of 6 inches in a manner to prevent intermingling with underlying subsoil or 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.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

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. 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 311000

SECTION 312000 - EARTH MOVING

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. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements and turf and grasses.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks.
6. Subbase and base course for asphalt paving.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C136	2006 Sieve Analysis of Fine and Coarse Aggregates
ASTM D698	2007 (Rev. 1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft- lbf/ft3 (600 kN-m/m3))
ASTM D1557	2007 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))
ASTM D1586	2008 (Rev. A) Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
ASTM D2487	2006 (Rev. 1) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2729	2003 Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D2855	1996 (Rev. 2002) Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

ASTM D6938	2008 (Rev. A) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D3212	2007 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F402	2005 Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F758	1995 (Rev 2007, E1) Standard Specification for Smooth-Wall P o1 y (Vinyl Chloride) (PVC) Plastic Underdrain Systems for High-way, Airport, and Similar Drainage

ARMY CORPS OF ENGINEERS (COE)

COE EM-385-1-1 2008 Safety and Health Requirements Manual

State of Maine, Department of Transportation MDOT Standard Specifications, 12/2002 and amendments.

Reference Standard Specifications: Materials and workmanship specified herein with reference to MDOT Maine State Standard shall be in accordance with the referenced articles, sections, and paragraphs of the standard except that contractual and payment provisions do not apply.

1.4 DEFINITIONS

A. Backfill: Soil 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.

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. Coarse Aggregate: A layer of clean, poorly graded crushed rock, stone, or gravel having a high porosity which is placed beneath or adjacent to a building slab or structure with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below or adjacent a slab or structure.

F. Compaction: The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in ASTM D698 or ASTM D1557 for general soil types abbreviated in this specification as "95 percent ASTM D1557 maximum density".

G. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

H. 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 changes in the Work.
2. 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.

I. Fill: Soil materials used to raise existing grades.

J. Fine Aggregate: Aggregate passing the 3/8-inch sieve and almost entirely passing the No. 4 sieve and predominantly retained on the No. 200 sieve, as determined by ASTM C125.

K. Granular Fill: A dense, well-graded aggregate mixture of sand-gravel or crushed stone with suitable binder soil, placed on a subgrade to provide a suitable foundation for further construction.

L. Hard Material: Weathered rock, dense consolidated deposits, or conglomerate materials, (excluding manmade materials such as concrete) which are not included in the definition of "rock," but which usually require the use heavy excavation equipment with ripper teeth or the use of jack hammers for removal. Material indicated in the soil boring logs as having a standard penetration resistance as determined by ASTM D1586 between 60 and 120 blows per foot is arbitrarily defined herein as "Hard Material".

M. Ledge: Where used in this section, the term "Ledge" and "Rock" shall be considered the same and may be used interchangeably. The definition of "Ledge" shall be the same as "Rock" as defined in this section

N. Loam: In natural or undisturbed soil formations, the fine-grained, weathered material on the surface or directly below any loose or partially decomposed organic matter. Loam may be a dark-colored, fine, silty, or sandy material with a high content of well-decomposed organic matter, often containing traces of the parent rock material. Gradation and material requirements specified herein apply to all loam references in this contract. The material shall be representative of productive soils in the vicinity

O. Rock: Solid, homogeneous, interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also, large boulders, buried masonry, or concrete other than pavement, exceeding three (3) cubic yard in volume. Material indicated in the soil boring logs as having a standard penetration resistance as determined by ASTM D1586 greater than 120 blows per foot is arbitrarily defined herein as "Rock." Removal of "hard material" will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

P. Soil: The unconsolidated surface material of the earth's crust resulting from the chemical and mechanical weathering of rock and organic material

Q. Structural Fill: Granular fill material constructed to attain maximum bearing strength and minimize consolidation or differential settlement under a load.

R. 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.

S. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

T. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

U. Unsatisfactory Material: Existing, in-place soil or other material which can be identified as having insufficient strength characteristics or stability to carry intended loads in fill or embankment without excessive consolidation or loss of stability. Materials classified as PT, OH, or OL by ASTM D2487 are unsatisfactory. Unsatisfactory materials also include poor manmade fills, refuse, frozen material, uncompacted backfills for previous construction, unsound rock, or soil lenses, or other deleterious or objectionable material.

V. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.5 SUBMITTALS

A. Field Test Reports (Note - Reports shall be as specified herein and as per applicable ASTM Standards).

1. All aggregate, granular fill tests/gradation report.
2. Subsurface drains, granular fill tests
3. Structural fill material tests/compaction report.
4. Compaction tests
5. General site fill/gradation report.
6. As specified within this section.

1.6 DELIVERY AND STORAGE

A. Deliver and store materials in a manner to prevent contamination or segregation. Store synthetic fiber filter cloth to prevent exposure to direct sunlight in accordance with the manufacturer's written recommendations.

1.7 FIELD CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

B. Do not commence earth-moving operations until plant-protection and Temporary Erosion Control measures, as specified in Sections 015639 "Temporary Tree and Plant Protection" and 312500 “Temporary Erosion Control Measures” are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Structural Fill: Soil material, free from organic matter, contaminants, frozen material and other deleterious substances graded in accordance with ASTM C136 with the following limits:

Sieve Size	Percent Passing
4 inches	100
3 inch	90 to 100
1/4 inch	25 to 90
No. 40	0 to 30
No. 200	0 to 6.0

Aggregate for foundation backfill shall only contain particles of rock that will pass the 100mm [4 in] square mesh sieve

C. Aggregate (Gravel): (MDOT Type A): Aggregate for base shall be screened or crushed gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of the part that passes a 75 mm [3 in] sieve shall meet the grading requirements of the following table:

Sieve Size	Percent Passing
½ inch	45 to 70
¼ inch	30 to 55
No. 40	0 to 20
No. 200	0 to 5

Type A aggregate for base shall only contain particles of rock that will pass the 50mm (2 in) square mesh sieve.

Aggregate (Gravel): (MDOT Type B): Aggregate for base shall be screened or crushed gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of the part that passes a 75 mm [3 in] sieve shall meet the grading requirements of the following table.

Sieve Size	Percent Passing
½ inch	35 to 75
¼ inch	25 to 60
No. 40	0 to 25
No. 200	0 to 5

Type B aggregate for base shall only contain particles of rock that will pass the 100mm [4 in] square mesh sieve.

D. Aggregate (Gravel): (MDOT Type C): Aggregate for base shall be screened or crushed gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of the part that passes a 75 mm [3 in] sieve shall meet the grading requirements of the following table.

Sieve Size	Percent Passing
¼ inch	25 to 70
No. 40	0 to 30
No. 200	0 to 5

Type C aggregate for base shall only contain particles of rock that will pass the 150 mm [6 in] square mesh sieve.

E. Aggregate (Gravel): (MDOT Type D): Aggregate for subbase shall be sand or gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of the part that passes a 75 mm [3 in] sieve shall meet the grading requirements of the following table:

Sieve Size	Percent Passing
¼ inch	25 to 70
No. 40	0 to 30
No. 200	0 to 7

Type D Aggregate for subbase shall not contain particles of rock which will not pass the 150 mm [6 in] square mesh sieve.

F. General Site Fill: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. Provide a soil material from the site or borrow that can be readily compacted to the specified densities and meeting requirements as follows:

Sieve	Percent Passing
6 inch	100
1/4 inch	25-90
No. 40	0-50

Materials shall be free of organic material, peat, clay, and other similar soft materials and may include blast ledge material up to 6" in diameter.

G. Loam: Loam shall be as covered in Section 329200 - "Turf and Grasses."

H. Aggregate 1 ½" (Stone); 1 ½" Crushed stone; washed, free of clay, shale, organic matter; graded in accordance with ASTM C136; to the following limits:

Minimum Size: 1 inch
Maximum Size: 2 inch

I. Aggregate ¾" (Stone); ¾" Crushed stone; washed, free of clay, shale, organic matter; graded in accordance with ASTM C136; to the following limits:

Sieve Size	Percent Passing
1 inch	100
3/4 inch	90-100
1/2 inch	25 to 55
3/8 inch	0 to 15
No. 4	0 to 5

J. Fine Aggregate (leveling Sand): Shall be sand of hard durable particles free from vegetable matter, lumps, ball of clay and other deleterious substances. The gradation shall meet the following grading requirements:

Sieve Size	Percent Passing
3/8 inch	85 to 100
No. 200	0 to 5.0

K. Loam: Loam shall be as covered in Section 310500- "Loam, Seeding and Sodding."

PART 3 - EXECUTION

3.1 PROTECTION

A. Shoring and Sheeting: Provide shoring bracing, underpinning, and sheeting where required.

1. Prevent undermining of pavements, foundations, and slabs.
2. Slope banks where space permits.
3. Where shoring and sheeting materials remain in place in completed work to prevent settlements or damage to adjacent structures or as directed, backfill the excavation to 3-feet below the finished grade and remove the remaining exposed portion of the shoring before completing the backfill.

B. Dewatering: Dispose of surface water, which may accumulate in open excavations, unfinished fills, or other low areas. Remove water by trenching where approved, pumping,or other methods to prevent softening of exposed surfaces. Surface dewatering plan shall include rerouting of any storm water runoff or natural drainage if necessary and shall comply with environmental requirements. Collect and dispose of surface and subsurface water encountered in the course of construction

C. Water Removal: Remove water by pumping or other methods to prevent the softening of surfaces exposed by excavation. Before excavating below ground water level, place the dewatering system into operation. Lower the water levels at least one foot below the bottom and side slopes of the excavation. Relieve the hydrostatic pressure in pervious zones below the subgrade elevation in layered soils in order to prevent uplift. Use screens and gravel packs as necessary on the dewatering devices to prevent the removal of fines from the soil.

D. Operation and Performance: Operate the dewatering system continuously, 24-hours per day, and 7-days per week until construction work below existing water levels is complete. Measure and record the performance of the dewatering system at the same time each day by use of observation wells and piezometers installed in conjunction with the dewatering system. After placement of initial slabs and backfill, the water level may be allowed to rise but at no time allow it to rise higher than one foot below the prevailing level of excavation or backfill. Have a back-up pump and system available for immediate use.

E. Protection and Restoration of Surfaces: Protect newly graded areas from traffic, erosion, and settlements. Repair and reestablish damaged or eroded slopes, elevations or grades and restore surface construction prior to acceptance. Protect existing streams, ditches and storm drain inlets from water- borne soil by means of straw bale dikes, filter fabric dams as indicated on the drawings or as required for good construction practices and to meet all environmental regulations.

1. Disposal of Excavated Material: Dispose of excavated material in such a manner that it will not obstruct the flow of runoff, streams, endanger a partly finished structure, impair the efficiency or appearance of facilities, or be detrimental to the completed work.

2. Disposal of Rock. Remove all excess rock off-site.

3.2 SURFACE PREPARATION

A. Erosion Control: Perform as specified in Section 32 13 74, "Erosion control”

B. Stockpiling Loam: Strip approved loam to a depth of 4 to 6-inches from the site where excavation or grading is indicated and stockpile separately from other excavated material. Stockpiled loam shall be the Contractor's property. Locate loam so that the material can be used readily for the finished grading. Protect and store in segregated piles until needed.

C. Unsatisfactory Material: Remove organic matter, sod, muck, rubbish, and unsuitable soils under embankments, which are less than 3-feet in thickness and under pavements or slabs on grade. Typical depth of removal of such unsuitable material shall be 18 inches unless otherwise indicated.

D. Subgrade Proof Rolling: Proofrolling of subgrade soils shall be done only as noted on project drawings and with authorization of the Engineer. Proof rolling shall be done in the presence of the Engineer. Perform proof rolling only when weather conditions permit. Do not proof roll wet or saturated subgrades. Wet or saturated materials degraded by unauthorized proof rolling shall be replaced by the Contractor as directed by the Engineer at no cost to the Owner. Notify the Engineer 2-days prior to proof rolling.

3.3 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 materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

B. Excavate to the contours and dimensions indicated. Keep excavations free from water while construction is in progress. Notify the Engineer immediately in writing in the event that it becomes necessary to remove rock, hard material, or other material defined as unsatisfactory to a depth greater than indicated on the drawings. Refill excavations cut below the depths indicated with granular fill and compact as specified herein. Excavate soil disturbed or weakened by construction operations or softened from exposure to weather. Refill with granular fill and compact as specified herein

C. Rock: Remove rock to the elevations indicated by drilling or approved methods in such a manner that will leave foundation rock in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bonding with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion. Removal of rock beyond the lines and grades indicated unless previously authorized by the Engineer will not be grounds for a claim for additional payment.

D. Shoring and Sheeting: Where required, shore and sheet excavations as described in the submitted plan, with various members sized and arranged to prevent injury to persons and damage to structures. Also arrange shoring and sheeting to preclude injurious caving during removal.

3.4 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.

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.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

3.7 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.

3.8 BACKFILL

A. Subgrade Preparation: Step, bench, or break up sloped surfaces steeper than one vertical to 4-horizontal so that the fill material will bond with or be securely keyed to the existing material. Compact with equipment well suited to the soil being compacted. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

B. Fill and Backfill Beside Structures: Place required backfill material adjacent to structures and compact in a manner that prevents wedging action or eccentric loading upon or against the structures. Step or serrate slopes bounding or within areas to be backfilled to prevent sliding of the fill. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Do not place material on surfaces that are muddy, frozen, or contain frost. Do not use equipment for backfilling

operations or for the formation of embankments against structures that will overload the structure. Backfilling against concrete will be done only after the concrete has attained at least 70% of its 28-day compressive strength and approval has been obtained from the Engineer.

C. Structural Fill: Place fill under spread footing, concrete slabs not pile supported, and pavements in loose lifts of 9-inches maximum. Do not place material on surfaces that are muddy, frozen, or contain frost. Compact with equipment well suited to the soil being compacted. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact each lift as specified herein before placing the overlaying lift. Compaction shall be accomplished continuously over the entire area. Sufficient passes shall be made to ensure that specified density is obtained.

D. General Site Fill: Construct site fill, at the locations and to lines and grades indicated on the drawings. Use only approved materials in constructing fill upon the prepared subgrade. Place satisfactory material in horizontal lifts not exceeding 18-inches in loose depth. Do not place material on surfaces that are muddy, frozen, or contain frost. Compact with equipment well suited to the soil being compacted. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact each lift as specified before placing the overlaying lift.

E. Fill for Coarse Aggregate Under Slab: Place material over compacted subgrade. Compact and test the material. Then install the vapor barrier. Then install, compact, and test the upper layer of material.

F. Weather Limitations: Fill and backfill shall not be constructed when weather conditions detrimentally affect the quality of the finished course. Place fill and backfill only if the atmospheric temperature is above freezing in the shade and is rising. Do not construct fill and backfill in the rain or on saturated subgrades. If weather conditions are windy, hot, or arid, with high rate of evaporation, schedule the placement in cooler portions of the day and furnish equipment to add moisture to the fill or backfill during and after placement.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

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. Initial Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 4 inches any dimension, to a height of 12 inches over the pipe or conduit.

1. 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.

E. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

F. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.10 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) 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 each layer or lift of material specified so that the in-place density tested is not less than the percentage of maximum density specified. General fill below grassed areas shall be compacted to at least 90% of its maximum dry density as determined by ASTM D1557. Fill materials for all other areas shall be compacted to at least 95% of ASTM D1557 unless otherwise noted.

3.11 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.

B. Site Rough 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. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.12 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. Shape subbase course and base course to required crown elevations and cross-slope grades.
2. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
3. 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.

3.13 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than **95** percent of maximum dry unit weight according to ASTM D698.

3.14 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform inspections:

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. 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.

D. 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.

E. 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.

3.15 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 312000

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 patching.
2. Hot-mix asphalt paving.
3. Hot-mix asphalt paving overlay.

B. Related Sections:

1. Division 02 Section "Selective Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: For each job mix proposed for the Work.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Material Test Reports: For each paving material.

1.5 REFERENCES

A. American Society for Testing and Materials
1. ASTM D946 - Penetration-Graded Asphalt Cement for Use in Pavement Construction.
2. ASTM D3381 - Viscosity Graded Asphalt Cement for Use in Pavement Construction.

B. State of Maine, Department of Transportation
   1. Standard Specifications – Highways and Bridges.
   2. Special Provision Corrections, Additions, and Revisions Standard Specifications Highways and Bridges (Latest Version).
   3. Standard Details Highways and Bridges (Latest Revision).
   4. Standard Details Supplemental Revisions Highways and Bridges (Latest Version).

C. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

1.6 GENERAL NOTES

A. All Hot Mix Asphalt workmanship shall conform to the standards set forth by the Maine Department of Transportation in the "Maine Department of Transportation Standard Specifications Highways and Bridges" (Latest Version) as well as any supplemental conditions or special provisions published the Maine Department of Transportation. Documents of special interest are as listed in section "1.2 References".

B. Pavement for parking and drive aisles of this project shall consist of 9.5mm surface material and of 19.0mm Binder material, thickness as specified on drawings, with bituminous tack coat applied between lifts at an application rate as stated in "Maine Department of Transportation Standard Specifications Highways and Bridges".

1.7 PROJECT 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. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.
   2. Place bitumen mixture when temperature is not more than 15 degrees F below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Asphalt Cement: In accordance with State of Maine DOT Standard Specifications - Highways and Bridges.

B. Aggregate for Base Course Mix: In accordance with State of Maine DOT Standard Specifications - Highways and Bridges.

C. Aggregate for Binder Course Mix: In accordance with State of Maine DOT Standard Specifications - Highways and Bridges.

D. Aggregate for Wearing Course Mix: In accordance with State of Maine DOT Standard Specifications - Highways and Bridges.

E. Primer: In accordance with State of Maine DOT Standard Specifications - Highways and Bridges.

F. Tack Coat: In accordance with State of Maine DOT Standard Specifications - Highways and Bridges.

G. Reclaimed Asphalt Pavement (RAP): Processed material obtained by milling or full depth removal of existing asphalt concrete pavements.

2.2 MIXES

A. Use dry material to avoid foaming. Mix uniformly.

B. Binder Course: Grade 19mm accordance with State of Maine DOT Standard Specifications - Highways and Bridges.

C. Surface Course: Grade 9.5 mm accordance with State of Maine DOT Standard Specifications - Highways and Bridges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify gradients and elevations of base are correct.

B. Verify that subgrade is dry and is ready to support paving and imposed loads.

C. 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. 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.

D. Proceed with paving only after unsatisfactory conditions have been corrected

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into 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: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving 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. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course in accordance with State of Maine DOT Standard Specifications - Highways and Bridges

C. Tack Coat: Apply uniformly to surfaces of existing pavement
1. Apply tack coat in accordance with State of Maine DOT Standard Specifications - Highways and Bridges
2. Apply tack coat to contact surfaces of curbs.
3. Coat surfaces of manhole and catch basin frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.4 HOT-MIX ASPHALT PLACING

A. Install Work in accordance with State of Maine DOT Standard Specifications - Highways and Bridges

3.5 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.

1. Clean contact surfaces and apply tack coat to joints.

3.6 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch
2. Surface Course: Plus 1/4 inch no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
    c. Replace and compact hot-mix asphalt where core tests were taken.
    d. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.
    e. Quality Requirements: Field inspecting, testing, adjusting, and balancing.

3.8 PROTECTION OF FINISHED WORK

A. Execution Requirements: Protecting finished work.

B. Immediately after placement, protect pavement from mechanical injury until surface temperature is less than 140 degrees F.

3.9 DISPOSAL

A. Retain this article if repairs, patching, or cold milling of existing pavement is required.

B. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 321374 - EROSION CONTROL

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 DESCRIPTION OF WORK

A. The work under this section shall include provision of all labor, equipment, materials, and maintenance of temporary erosion control devices, as specified herein, as shown on the Drawings and as directed by the Engineer.

B. Erosion control measures shall be provided as necessary to correct conditions that develop prior to the completion of permanent erosion control devices, or as required to control erosion that occurs during normal construction operations.

C. Construction operations shall comply with all federal, state, and local regulations pertaining to erosion control.

1.3 SUBMITTALS

The Contractor shall furnish the Engineer, in writing, his work plan giving proposed locations for storage of topsoil and excavated material, before beginning construction. A schedule of work shall accompany the work plan. Acceptance of this plan will not relieve the Contractor of his responsibility for completion of the work as specified

1.4 REFERENCES

A. Maine Department of Environmental Protection (Maine DEP)
   1. Stormwater Management for Maine Best Management Practices (latest edition)
   2. Maine Erosion and Sedimentation Control Handbook for Construction – Best Management Practices

B. Maine Department of Transportation (Maine DOT)
   1. Standard Specifications - Highway and Bridges (latest edition)
   2. Standard Details – Highways and Bridges (latest edition)
   3. Highway Design Guide (latest edition)

1.5 ENVIRONMENTAL CONSIDERATIONS

A. The contractor shall protect adjacent properties and water resources from erosion and sediment damage throughout the life of the contract in accordance with Plans, Details, and Notes included in the plans. The erosion and sediment controls and applicable regulations have specific restrictions

on seasonal work limits, the amount of area, which can be exposed at a given time, the general sequence of construction, and contractor monitoring.

B. The general contractor will be required to designate, by name, a Registered Professional Engineer or equivalent certified person responsible for implementation of all erosion control measures for the project. Specific responsibilities include:

1. Assuring and certifying the contractor's construction sequence is in conformance with the specific schedule. In addition, a weekly certification stating compliance, any deviations, and corrective measures shall be filed with the owner by this person.
2. Inspection of the project work site on a weekly basis, with the installation of added erosion control measures in areas, which appear vulnerable to erosion.
3. Inspection of all erosion control measures and drainage inlets after any significant rainfall. Accumulated silt/sediment should be removed when the depth of sediment reaches 50% of the barrier height. Accumulated silt/sediment should be removed from behind silt fencing when the depth reaches 6 inches. A significant rainfall shall be defined as over ½ inch of precipitation in any consecutive 24-hour period.
4. Inspect area for catch of grass. A minimum catch of 75% is required prior to removal of erosion control measures.

PART 2 PRODUCTS

2.1 MATERIALS

A. Quick growing grasses for temporary seeding (see seed mixes contained in Erosion Control Notes of plans.
B. Hay or straw bales.
C. Fencing or wood waste mulch for siltation control as specified on plans.
D. Curlex blankets by American Excelsior Company or approved equivalent.
E. Bale stakes shall be a minimum of 4 feet in length and 1" in width.
F. Temporary mulches such as loose hay, straw, netting, wood cellulose or agricultural siltage.
G. Fence stakes will need to be a minimum of 8 feet in length.
H. Stone sediment Barriers or SiltSacks™, or approved equal for inlet protection.
I. A stabilized construction entrance, if specified, shall be constructed temporarily.
J. Riprap for slopes, culvert, storm drain inlet, and outlet aprons.
K. Geogrid stabilization mat by Tensar Inc. or approved equivalent.

PART 3 EXECUTION

3.1 PREPARATION

A. Review site plans.

B. Deficiencies or changes in erosion control plan as it is applied to current conditions will be brought to the attention of the Engineering for remedial action.

3.2 EROSION CONTROL AND SLOPE PROTECTION IIMPLEMENTATION

A. Provide catalog cuts and information concerning the erosion control products, which will be used for construction for review by the Owner.

B. Provide information concerning the installation of the erosion sedimentation control including anchorage trench provisions and anchorage devices and spacing for review by Owner.

C. Place erosion control systems in accordance with the plans and in accordance with approved installation procedures.

D. The Engineer in has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow, and embankment operations. The Owner has the authority to direct the Contractor to provide immediate permanent or temporary pollution control measures. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practical time to minimize the need for temporary controls. Cut slopes shall be permanently seeded and mulched as the excavation proceeds to the extent considered desirable and practical.

E. The temporary erosion control systems installed by the Contractor shall be maintained as directed by the Engineer to control siltation at all times during the life of the Contract. The Contractor must respond to any maintenance or additional work ordered by the Engineering within a 48-hour period.

F. Any additional material work required beyond the extent of the erosion control plan shall be paid for by the Owner except where such measures are required to correct deficiencies caused by the failure of the Contractor to construct the work in accordance with the erosion sediment control plan.

END OF SECTION

SECTION 32 92 00 –LAWNS

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 and over-seeding.
2. Temporary protective coverings.
3. Temporary protective fencing.
4. Protecting and maintaining all lawn areas.
5. Cleaning up.

B. Related Sections:
1. Division 01 Section 32 13 74 Erosion Control
2. Division 31 Section 31 20 00 Earth Moving

1.3 ALLOWANCES

A. As described in Division 01 Section 01 21 00.

1.4 DEFINITIONS

A. Applicable specifications and publications, referred to herein, form a part of these Specifications:

1. Standard Specification: The State of Maine Department of Transportation, Standard Specification for Highways Bridges, latest edition.

2. ASTM: American Society of Testing Materials

3. AASHTO: American Association of State Highway and Transportation Officials

4. AAN: American Association of Nurserymen

5. AOAC: Association of Official Agricultural Chemists

1.5 SUBMITTALS

A. Prior to ordering the below listed materials, submit representative samples to Owner for selection and approval as follows. Do not order material until Owner's approval has been obtained. Delivered materials shall match the approved samples.

1. Protective fencing materials: Provide three 12 inch square samples for approval.

B. Submit material specifications and installation instructions where applicable attesting that the following materials meet the requirements specified:

1. Fertilizer
2. Sod
3. Seed
4. Lime

C. Certificates

1. A manufacturer's Certificate of Compliance to the specifications shall be submitted by the manufacturers with each shipment of each type of seed and sod. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.

2. Contractor: Submit certification from the seed and sod supplier that all seed is true to the variety indicated on the packaging.

3. Furnish the Owner with duplicate signed copies of a statement from the vendor certifying that the sod and seed mix is of the specified grass varieties, free of weeds, disease or other visual imperfections.

D. Submittal Schedule

1. Before installation:
   a. Manufacturer's Product data
   b. Test Reports
   c. Seed Certification
   d. Protective Fencing

1.6 QUALITY ASSURANCE

A. Work under this section will be performed by workmen experienced in meadow turf grass installation under the full time supervision of a qualified foreman.

B. Seed during recommended planting period or as approved by the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver material to the site in original unopened packages, showing weight, manufacturer's name and guaranteed analysis.

B. Store materials in such a manner that effectiveness and usability will not be diminished or destroyed and shall be uniform in composition, dry, unfrozen and free flowing. The Owner reserves the right to reject any material which has become caked or otherwise damaged or does not meet specified requirements.

1.8 COORDINATION

A. Contractor: Submit to the Owner for approval a progress schedule as specified herein.

B. Contractor: Coordinate the Work with other trades so as not to interfere with the progress of the Work.

1.9 WARRANTY

A. Contractor: agrees to repair or replace any or all meadow turf grass and lawn area(s) that fail(s) in materials or workmanship within a period of one year from date of substantial completion or completion thereafter on punch-out list.

PART 2 - PRODUCTS

2.1 TOPSOIL

TOPSOIL ADDITIVES

A. Commercial Fertilizer for Lawns: CID A-A-1909, Type I, class 2, with 50 percent of the nitrogen in slowly available form, containing at least 10 percent nitrogen, 0 percent phosphoric acid, and 10 percent total available potash in conformity with the Standards of the Association of Official Agricultural Chemists. Do not apply fertilizer on lawn surfaces within 100 feet of a stream, shore land or open water body. Supply in unopened bags with the weight, contents, and guaranteed analysis shown thereon or on a securely attached tag. Contractor to confirm with Owner and all authorities having jurisdiction the type of fertilizer to be used prior to application.

B. Limestone: Dolomitic limestone and contain not less than 85 percent of total carbonates and magnesium and shall be ground to such fineness that 50 percent will pass a 100 mesh sieve and 90 percent will pass through a 20 mesh sieve. Coarser material will be accepted provided the specified rates of application are increased proportionately on the basis of quantities passing the 100-mesh sieve.

C. Water: The Government will furnish the Contractor upon request with an adequate source and supply of water at no charge. However, if the Government's water supply is not available or not functioning, the Contractor will be held responsible to furnish adequate supplies at his own cost. All injured or damaged plant material due to the lack of water, or the use of too much water, to be the Contractor's responsibility to correct. Water to be free from impurities injurious to vegetation. Contractor to supply their own hoses and sprinklers.

2.2 SEED

A. Lawn Seed Mixture

To be used in lawn areas adjacent to new building, in parking islands and disturbed areas adjacent to existing facilities

Species	Proportion of mix After purity	Minimum Germination
Van Gogh Tall Fescue	25.00%	90%
Monet Tall Fescue	25.00%	90%
Rembrandt Tall Fescue	25.00%	90%
Picasso Tall Fescue	25.00%	90%

Seed at a rate of 10 lbs. per 1000 S.F.

B. Meadow Seed Mixture:

To be used in disturbed areas at perimeter of project area (such as slopes behind parking area) where designated by landscape architect.

Meadow Seed mixture: Fresh, clean, new crop seed. Seed may be mixed by an approved method on the site or may be mixed by the dealer. If the seed is mixed on the site, each variety shall be delivered in the original containers bearing the dealer's guaranteed analysis. If seed is mixed by the dealer, the Seeding Contractor shall furnish to the Contracting Officer the dealer's guaranteed statement of the composition of the mixture and the percentage of purity and germination of each variety.

Meadow Seed Mixture:

Species	Proportion of mix after purity	Minimum Germination
Bluegrass	30%	80%
Little Bluestem	20%	80%
Timothy	20%	80%
Side oats gramma	20%	80%
Annual Rye Grass	10%	90%

Seed at a rate of 8 lbs. per 1000 S.F.

2.3 PROTECTIVE FENCING

B. Sod and Seeded areas adjacent to walks shall be protected by snow fencing or other temporary fencing material as approved by the Owner.

2.4 TEMPORARY PROTECTIVE COVERINGS

C. As temporary protective coverings on ground areas subject to erosion, provide one of the following protective measures, as directed by the Owner:

1. Mulch Materials

	Rate per 1,000 SF
a. Straw	50 lbs.

2. Mesh or Blanket Matting: Matting for erosion control on seeded or hydroseeded slopes, on planted surfaces, drainage swales and on temporary or permanently finished slopes of 3:1 or steeper shall be:

a. Heavy jute mesh shall be of a uniform open plain weave of unbleached singe jute yarn. The yarn shall be of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than one half its normal diameter. The jute mesh shall be furnished in approximately 90 pound rolled strips and shall meet the following requirements:

1. Length – approximately 75 yards. Width – 48” plus or minus 1”. .78 warp ends per width of cloth. 41 weft ends per yard. Weight of cloth to average 1.22 pounds per linear yard with a tolerance of plus or minus 5%.

b. Staples shall be of a #11 guage steel wire formed into a “U” shape 6” long.

c. Erosion control matting shall be “Soil Saver” as manufactured by Jim Walls Co., Dallas, TX or “Heavy Duty Jute Mesh” as manufactured by Lewis International Corp., Springfield, NJ, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine site conditions and other conditions affecting performance of the Work. Insure the sub-grade is properly graded and at correct levels prior to spreading of topsoil.

B. Examine specified materials before installation. Reject materials that are damaged or otherwise not as specified and shown on the Drawings. Reject soil amendments that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected and approved by the Owner.

D. The Contractor shall be responsible for maintenance work on the installed meadow turf grass until an acceptable meadow turf grass is established and accepted in writing.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Topsoil:

The dates for seeding shall be as follows:

1. Spring – April 15 to June 15.
2. Autumn – September 1 to October 15.

Seeding at any time other than within the above seasons shall be allowed only when ordered by the Owner or when the Contractor submits a written request for permission to do so and permission is granted. Newly seeded areas, if seeded out of season, must be continuously watered according to good practice if seeding is done between June 1 and September 1. Seeding done outside the dates established above shall be solely at the Contractor's risk.

3.3 OVERSEEDING

A. Overseed the entire lawn area –tea ;awn and surrounding lawn areas as shown on drawings using the seed as specified under Section 2.3 herein. Seed rate: 8 lbs. per 100 Square Feet.

3.4 WATERING

B. Watering of Lawn Areas:

1. First Week: The contractor shall provide all labor and arrange for all watering necessary to establish an acceptable meadow turf grass. In the absence of adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantities to maintain moist soil to a depth of at least 2 inches. An Irrigation system is proposed and should be working. The Contractor is not excused from monitoring or furnishing water by other means if the irrigation system is not in operation for any reason.

2. Second and Subsequent Weeks: The Contractor shall water the meadow turf grass and lawn as required to maintain adequate moisture in the upper 5 inches of soil, necessary for the promotion of deep root growth.

3. Watering shall be done in a manner which will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. Contractor: Furnish sufficient watering equipment to apply one complete coverage to the seeded areas in an eight-hour period

3.5 TEMPORARY PROTECTIVE FENCING

A. Place temporary protective fencing in locations as directed by the Contract Officer.

3.6 MAINTENANCE

A. Maintenance shall begin immediately after each portion of meadow turf grass and lawn areas are installed and shall continue in accordance with the following requirements:

1. Lawn area: Maintain as long as is required to establish a uniform, thick, well-developed stand of grass until final acceptance.

2. Mowing for Turf Grasses: Mowing is not required for the first year. Mow only during the month of November or as otherwise directed by the Owner to a height of 2 inches.

3. Mowing for Lawn Areas: Mow with sharp mower blades. Mow lawn areas so as to maintain a minimum height of 2 inches and a maximum of 4 inches.

4. All areas which fail to show a uniform, thick, well-developed stand of grass, for any reason, shall be re-seeded repeatedly until all areas are covered with a satisfactory growth of grass as determined by the Owner.

5. All damage from erosion, gullies, washouts, or other causes shall be repaired immediately by filling with topsoil, tamping, re-fertilizing and reseeding at no additional cost to the Government.

B. Protection:

1. Lawn areas shall be protected against damage with the type fencing specified herein. Any protective devices remaining on the site shall be removed at Substantial Completion of the Contract or as directed by the Contract Officer.

3.7 STANDARDS FOR COMPLETION

A. Conditions for Completion:

1. Completion of meadow turf grasses and lawn areas is for the entire area. No partial completion will be given unless otherwise approved by the Contract Officer.

2. Meadow turf grasses and lawn areas: Exhibit a uniform, thick, well- developed stand of grass. Meadow turf grass areas shall have no bare spots in excess of four inches in diameter and bare spots shall comprise no more than two percent of the total area of that meadow turf grass and lawn area.

3. No meadow turf grass or lawn areas shall exhibit signs of damage from erosion, washouts, gullies, or other causes.

4. Pavement surfaces and site improvements adjacent to meadow turf grass and lawn areas shall be clean and free of spills or over-spray from placing or handling of topsoil and seeding operations.

B. Inspection and Completion:

1. Upon written request of the Contractor, the Owner to inspect all meadow turf grass areas to determine completion of Contract work. This request must be submitted at least 10 days prior to the anticipated inspection date.

2. Upon written request of the Contractor, the Owner to inspect all grass areas to determine completion of Contract work. This request must be submitted at least five days prior to the anticipated inspection date.

3. If the meadow turf grass and lawn areas are deemed complete to the Owner, a meeting will be arranged with Contractor and Government to review the meadow turf grass and lawn work. A final inspection is a part of this meeting to insure completion and any punch list items.

4. Contractor: Following the completion of meadow turf grasses and lawn areas, provide the Government with access to all grass areas as required for the Government's maintenance work.

C. Cleanup:

1. Contractor: Following the completion of meadow turf grasses and lawn areas, immediately remove from the site all materials and equipment not required for any other planting or maintenance work. Store materials and equipment remaining on site locations which do not interfere with the Government's maintenance of completed meadow turf grasses, lawn areas or other construction operations.

2. The Contractor is responsible for keeping all paving, building surfaces, signs, posts, and all site improvements clean during placement of topsoil and seeding operations. Clean up spills and over-sprays immediately. Completion shall not be granted until this condition is met.

END OF SECTION 32 92 00

SECTION 32 93 00 - PLANTING

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. Preparation of Backfill Mix
2. Furnish and install trees, shrubs, grasses
3. Maintenance.

B. Related Sections:

1. Division 32 Section 32 94 00 Topsoil
2. Division 32 Section 32 92 00 Lawns

1.3 ALLOWANCES

A. As described in Division 01 Section 01 21 00.

1.4 DEFINITIONS

A. Applicable specifications and publications, referred to herein, form a part of these Specifications:

1. Standard Specification: The State of Maine Department of Transportation, Standard Specification for Highways Bridges, latest edition.
2. ASTM: American Society of Testing Materials
3. AASHTO: American Association of State Highway and Transportation Officials
4. AAN: American Association of Nurserymen

5. AOAC: Association of Official Agricultural Chemists

B. All work shall conform to the Drawings and Specifications and comply with applicable codes and regulations.

C. All areas to be planted to be inspected by the Contractor before starting work and any defects such as incorrect grading, etc., to be reported to the Owners Representative prior to beginning this work and subsequently corrected to the satisfaction of the Owners Representative. The commencement of Work by the Contractor indicates his acceptance of the areas to be planted, and he is to assume full responsibility for the work of this section.

D. Contractor: Remove from site all waste material resulting from planting.

1.5 SUBMITTALS

A. Prior to ordering the below listed materials, submit representative samples to Owners Representative for selection and approval as follows. Do not order material until Owners Representative's approval has been obtained. Delivered materials to match the approved samples.

1. Pine Bark Mulch: Submit one (l) cubic foot sample.

2. Peat: Submit one (1) cubic foot sample.

3. Compost: Submit Certificate of Compliance listing analysis.

4. Anti-dessicant: Submit manufacturer.

5. Fertilizer: Submit Certificate of Compliance listing analysis.

6. Tree Stakes and Webbing: 1 Stake with approved stain (if applicable) and 3 foot length of webbing.

7. Tree Stakes and Webbing: Product label and manufacturers certificate(s).

1.7 QUALITY ASSURANCE

A. Plant names shall comply with nomenclature of Hortus, latest edition. Sizing and grading shall be in accordance with ANSI Z60.1-86.

B. Notify Owners Representative in writing at least 15 days before plant delivery. All

plant materials shall be available for inspection at the nursery or collection source before plants are dug. Approval at plant source shall not be considered final acceptance.

1.8 PRODUCT HANDLING

A. Delivery:

1. Packaged Materials: Deliver in original, unopened containers showing weight, analysis, and manufacturer.

2. Plant Material: Before digging deciduous trees and shrubs in leaf and evergreen trees for shipping, apply anti-desiccant. Carefully pack plants to prevent breaking, damage to bark, branches, and root systems, and root ball cracking. Provide adequate ventilation. Protect roots and balls from sun, drying wind, and frost. Do not drop plants from vehicles. Legibly label plants with correct botanical name and common name.

3. Storage**:** Place plants not planted on the day of arrival in shaded storage, protected from wind and freezing. Open bundles and separate plants. Heel in bare root plants immediately on delivery and protect roots by puddling or other means to prevent drying. Cover root balls with moist sawdust, wood chips, shredded bark, peat moss, or other approved mulching material. Leave container grown plants in containers until planting. Keep all plants moist.

4. Store packaged materials in dry locations away from contaminants. Separate anti-desiccants and pesticides from other landscape materials.

1.9 COORDINATION

A. Contractor: Submit to the Owners Representative for approval a progress schedule as specified herein.

B. Contractor: Coordinate the Work with other trades so as not to interfere with the progress of the Work.

1.9 WARRANTY

A. Plants to be guaranteed for a period of one year after inspection from the date of substantial completion or completion thereafter on punch-out list and to be alive and in satisfactory growth at the end of the guarantee period.

B. At the end of the guarantee period, inspection will be made. Any plant required under this contract that is dead or unsatisfactory to be removed from the site.

C. All replacements to be plants of the same kind and size specified in the PLANT LIST. The cost to be borne by the CONTRACTOR, except for possible replacements due to vandalism or neglect on the part of others. Furnish plants, stake and wrapped if necessary, and mulch as required.

PART 2 - PRODUCTS

2.1 SOIL ADDITIVES

A. Commercial fertilizer, peat, humus or other additives to be used to counteract soil deficiencies as recommended by the soil analysis and as directed by the Owners Representative.

1. Commercial fertilizer to be a product complying with the State and United States Fertilizer Laws. Deliver to the site in the original unopened containers which to bear the manufacturer's Certificate of Compliance covering analysis which shall be furnished to the Owners Representative. At least 50% by weight of the nitrogen content will be derived from organic materials. A minimum of 35% of the nitrogen will be water insoluble. Fertilizer to contain not less than percentage of weight of ingredients as follows or as recommended by soil analysis:

	Nitrogen	Phosphorus	Potash
For deciduous (dry)	10%	6%	4%
trees & shrubs (water soluble)	16%	19%	16%
For evergreen (dry)	7%	7%	7%
trees & shrubs (water soluble)	21%	7%	7%

B. Humus will be natural humus, reed peat, or sedge peat. It to be free from excessive amounts of zinc, low in wood content, free from hard lumps and in a shredded or granular form and to pass through a 1/2 inch mesh screen. According to the methods of testing of A.O.A.C., latest edition, the acidity range to be approximately 5.5 pH to 7.6 pH and the organic content to be not less than 60% as determined by drying at 105 degrees C. The minimum water absorbing ability to be 200% by weight on an oven-dry basis.

C. Peat Moss to be composed of the partly decomposed stems and leaves of any or several species of sphagnum moss. It is to be free from wood, decomposed colloidal residue, and other foreign matter. It is to have an acidity range of 3.5 ph to 5.5 pH as

determined in accordance with the methods of testing of A.O.A.C., latest edition. Its water absorbing ability to be a minimum of 1,100% by weight on an oven-dry basis.

D. Compost to be well-rotted, unleached, stable manure not less than eight months and not more than two years old. It to be free from sawdust, shavings, or refuse of any kind and to not contain over 25% straw. The CONTRACTOR to furnish information as to kind of disinfectant or chemicals, if any, that may have been used in storage of the manure.

E. Bone meal to be fine ground, steam-cooked, packing house bone with a minimum analysis of 23% phosphoric acid and l.0% of nitrogen.

F. Leaf mold to be a highly organic dark brown to black spongy residue resulting from the well aerated composting of deciduous tree parts, free of plants and their roots, debris and other extraneous matter and to be uncontaminated by foreign matter and substances harmful to plant growth. The organic matter to not be less than 85% by weight as determined by the loss on ignition of oven-dried samples. Test samples to be oven-dried to a constant weight at a temperature of 16 degrees C. The inorganic residue after ignition to not be finer textured than 4% by weight passing the number 200 sieve with washing.

G. Sulfur for adjustment of loam pH to be commercial or flour sulfur, unadulterated, and to be delivered in containers with the name of the manufacturer, material, analysis, and net weight appearing on each container.

H. Dolomitic limestone for adjustment of loam pH to contain not less than 85% of total carbonates and to be ground to such fineness that 40% will pass through 100-mesh sieve and 95% will pass through a 20-mesh sieve. Coarser materials will be accepted provided the specified rates of application are increased proportionately on the basis of quantities passing the 100-mesh sieve.

2.2 PLANT MATERIALS

A. The CONTRACTOR will furnish and install all plants shown on the Drawings, as specified, and in quantities listed on the Plant List. No substitutions will be permitted without the written approval of Owners Representative. In case of conflict between the Planting Plan and the Plant List, Contractor to supply the plant material necessary to complete the Work as shown on the Drawings. All plants to be nursery grown unless specifically authorized to be collected.

B. Plants to be in accordance with the U.S.A. Standard for Nursery Stock of the American Association of Nurserymen, Latest edition.

C. All trees and shrubs to conform to the trade classification of "heavy specimen" and will exhibit distinctive character and form.

D. All Plants to be typical of their species or variety and to have a normal habit of growth and be legibly tagged with the proper name. Only plant stock within the hardiness Zone 1 through 5, as established by the Arnold Arboretum, Jamaica Plain, Massachusetts, will be accepted. The CONTRACTOR's suppliers must certify in writing that the stock has actually been grown under Zone 5 or hardier conditions. Plants not so certified will not be accepted.

E. The root system of each shall be well provided with fibrous roots. All parts to be moist and show active green cambium when cut. They to be sound, healthy and vigorous, well branched, and densely foliated when in leaf. They shall be free of disease, insect pests, eggs, or larvae.

F. All plants must be moved with the root systems as solid units with balls of earth firmly wrapped with untreated eight-ounce burlap, firmly held in place by a stout cord or wire. The diameter and depth of the balls of earth must be sufficient to encompass the fibrous and root feeding system necessary for the healthy development of the plant. No plant to be accepted when the ball of earth surrounding its roots has been badly cracked or broken prior to or during the process of planting or after the burlap, staves, ropes or platform required in connection with its transplanting have been removed. The plants and rootballs to remain intact during all operations. All plants that cannot be planted at once must be heeled in by setting in the ground and covering the rootballs with soil and then watering them.

G. Take caliper measurement six inches above ground for deciduous trees. Evergreen trees to be of specified height with spread in proportion to height, as designated in A.A.ll. U.S.A. STANDARD FOR NURSERY STOCK, latest edition, and to be well branched to the ground. The trunk of each tree to be a single trunk, unless listed as multi-stemmed in the plant list, growing from a single crown of roots. No part of the trunk to be conspicuously crooked as compared with normal trees of the same variety. The trunk to be free from sun scald, frost cracks, or wounds resulting from abrasions, fire, or other causes. No pruning wounds to be present having a diameter exceeding two inches and such wounds must show vigorous bark on all edges. Plants shall not be pruned prior to delivery. Pruning wounds over 3/4" in diameter must be completely callused over. Evergreen trees shall be branched to within one foot of the ground.

H. At least 50% of the plants furnished for each size range shown on the plants to be at or above the average between the maximum and minimum size specified. If a nursery supplies material at a specific size (not a range), then the larger size of the specified range to be furnished.

I. Plants delivered by truck and plants requiring storage on site to be properly wrapped and covered to prevent wind-drying and desiccation of branches, leaves or buds. Plant balls should be firmly bound, unbroken and reasonably moist to indicate watering prior to delivery and during storage. Tree trunks should be free from fresh scars and damage in handling. No trees with double-leaders or twin-heads to be accepted without the

written approval of the Owners Representative. The CONTRACTOR to reject such plants at time of delivery by the nursery/supplier unless such plants were selected by the Owners Representative as indicated by tags and seals. No plant material from cold storage will be accepted unless pre-selected by the Owners Representative.

J. Plant material which is to be planted after the specified seasons for planting shall be dug during the normal season for digging of the particular plant material and be stored and maintained in good health until planting. The CONTRACTOR shall assume all costs for maintaining plant material while it is being stored.

K. All plants to be free from plant diseases and insect pests, and to comply with all applicable State and Federal laws with respect to inspection for plant diseases and infestations.

L. All plant materials shall be available for inspection in the nursery or collecting fields before it is dug. The CONTRACTOR to provide a list of suppliers in sufficient time to allow the Owners Representative to inspect nurseries on a timely basis. Approval to move nursery Materials shall not be considered as final acceptance.

M. All planting stock to conform to the laws of The State of Maine and to be inspected before removal from the nursery, by authorized Federal, State or other authorities as may be required in the area where the nursery is located. The invoice or order for each shipment of plants to contain the project name and quantity and variety of plant material delivered. An inspection certificate to certify that the plants are free of disease and insect pests of all kinds shall accompany each shipment. Disease certificates and delivery slips to be given to the Owners Representative upon arrival of the plant material at the point of delivery.

N. Plants to be dug with care and skill. Special precautions to be taken to avoid any unnecessary injury to or removal of fibrous roots. Each species or variety to be handled and packed in the approved manner for that particular plant. All precautions to be taken to insure the arrival of plants at the project site in good condition for successful growth.

O. Balled and Burlapped Plants Rootball: Firm and composed of the original, undisturbed soil in which the plant has been grown. The plant shall be handled in such a manner that the soil in the ball will not drop away from the roots and will not cause stripping of the small, fibrous roots. The ball shall be wrapped with burlap or other approved material and tightly laced to hold the desired shape. No balled plants will be accepted if the ball is cracked or broken. A substitute for burlap may be approved provided it can be demonstrated that the material is tight enough to retain the soil ball securely. Any synthetic material used to wrap the rootball, which will not readily disintegrate in the ground, shall be removed or extensively cut to allow the roots to grow through freely.

P. Container Grown Plants: Well established in the container in which they are sold, and shall have sufficient roots to hold earth intact after removal, without being in a root bound condition. Plant shall remain in container until planted.

Q. Shrubs and Small Plants: All shrubs and small plants, unless otherwise designated, shall be well-formed and bushy with well-spaced side branches, and shall have a crown and stem(s) typical of the species and variety.

R. All soil in rootballs, containers, bare root stock and native sods shall be free from weeds, non native seeds and non native or noxious insects.

S. Requests for plant substitutions shall be made at least 14 days before the plants are to be delivered and such requests shall list at least 5 major nursery sources contacted for confirmation of unavailability.

T. The CONTRACTOR to notify the Owners Representative not less than 5 days in advance of delivery of plants.

2.3 TREE STAKING

A. Stakes: Sound cedar, fir or other suitable wood 2" x 2" or 2" x 4", as required, pointed at one end and stained at the discretion of the Owners Representative. Tree anchors, if required, to be malleable iron, "Universal Ground Anchor" or approved equal.

B. Tree-stake webbing: Consist of ¾” wide polypropylene with a 900 lb. Breaking strength. Color: olive drab or black as manufactured by Eaton Brothers Corporation, PO Box 68, Hamburg NY 14875. or "ADJ-A-TYE" heavy-duty poly chain lock, color: olive drab or black, as distributed by A.M. Leonard Inc, 241 Fox Drive, Piqua OH 45356-0816. or approved equal.

2.4 WATERING

A. The Owner will furnish the Contractor upon request with an adequate source and supply of water at no charge. However, if the Owner's water supply is not available or not functioning, the Contractor will be held responsible to furnish adequate supplies at his own cost. All injured or damaged plant material due to the lack of water, or the use of too much water, to be the Contractor's responsibility to correct. Water to be free from impurities injurious to vegetation. Contractor to supply their own hoses and sprinklers.

2.5 ANTI-DESICCANT

A. Anti-desiccant: Provide a natural product for the purpose of preventing desiccation to plant material drived from the resin of the pine tree which is called a polyterpene polymer or more specifically a beta-pinene polymer which is a film forming short chain of polymer component. Anti-desicant to contain two sub-units in the polymer for a molecular weight of 275. Anti-desiccant to be non-toxic and suitable for food crops. Potential manufacturer:

1. "Wilt-Pruf", available from Nursery Specialty Products, Inc., New York, NY, or approved equal, delivered in the manufacturer's container and used according to the manufacturer's instructions and per Owners Representative's approval.

2.6 MULCH

A. Mulch: Consist of the outer bark of evergreen trees and a minimum of hardwood bark, and shall be aged for a period of at least 6 months, and not longer than 2 years. The bark must be partially decomposed and dark brown in color, free of dirt and materials deleterious to plant life. No chunks 3 inches or more in size, and thicker than 1/4 inch shall be left on the site.

2.7 TREE WOUND DRESSING

A. Tree Wound Dressing: Non-toxic product for aesthetic purposes only specifically designed for tree wounds.

2.8 METAL WIRE FENCING FOR PLANT PROTECTION

A. Metal wire fencing for plant protection: 14 ga. Galvanized 1 inch by 1 inch square openings Wire fencing. Fencing to be 24" above ground (minimum) with 4 inches buried into the ground. Provide a 12" tall by 1 inch by 1 inch square openings fencing firmly secured to the top of the 24" ht. Fence at a 60 degree angle to the outside of the fenced area. Secure fence with hardwood stakes 4 feet O.C. as approved by the Owners Representative. Exact layout of fencing to be determined on site immediately after planting to protect material from porcupine damage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine site conditions and other conditions affecting performance of the Work. Insure the sub-grade is properly graded and at correct levels prior to spreading of topsoil, or if the topsoil has been spread, is at the proper depths and finish grades.

B. Examine specified materials before installation. Reject plant materials that are damaged or otherwise not as specified and shown on the Drawings. Reject soil amendments that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected and approved by the Owners Representative.

3.2 PLANTING

A. Planting of any plant material includes: Coordination with the nursery, shipment from the nursery, the digging of the holes, provision of the soil additives and loam, furnishing the plants of specified size with roots in the specified manner, the labor of planting and mulching and guying and staking where called for, and the removal of all excess or debris material created as a result of the work.

B. Coordination with Existing Conditions: Prior to excavating for any plants, and before installation of location stakes, the CONTRACTOR shall review all existing conditions below grade. Underground obstructions may exist in the form of project-installed improvements and/or pre-existing conditions. The CONTRACTOR to be liable for any damages resulting from his failure to ascertain subsurface conditions before proceeding with the work.

C. Planting:

1. Location for all plants to be staked on the ground by the CONTRACTOR for approval by the Owners Representative before any plant pits are dug. The CONTRACTOR shall move stakes as necessary to obtain the Owners Representative's approval. Once the staking is approved and all the trees have arrived, the CONTRACTOR to place all the trees at the staked locations for the Owners Representative’s secondary approval. The CONTRACTOR shall move trees as required by the Owners Representative. Then each plant location to be marked by outlining the rootball with a light application of lime. At this point the CONTRACTOR to begin excavating the planting pits. Once all the trees are placed in the planting pits, the Owners Representative to make a final inspection of the pits. Before beginning any backfilling, the CONTRACTOR shall, if necessary, rotate plants and/or correct plant pits as required by the Owners Representative. Once final approval has been given by the Owners Representative, the CONTRACTOR can proceed with the backfilling.

2. At least ten (10) days prior to the expected planting date, the CONTRACTOR shall request, in writing, that the Owners Representative provide a representative to select and tag stock to be planted under this Section. The CONTRACTOR shall pay for transportation and overnight accommodations, if necessary, for the

Owners Representative's representative during the period of time required to select and tag the plant material.

3. Plants to be selected by the Owners Representative's representative at the place of growth for conformity to specification requirements as to quality, size, and variety. Such approval to not impair the right of inspection and rejection upon delivery at the site or during the progress of the work. Cost of replacement to be borne by the CONTRACTOR.

4. Delivery and Temporary Storage: Plants shall be delivered in a moist, vigorous condition, free from dead wood, bruises, or other root or branch injuries. Insofar as is practical, plant material shall be planted on the day of delivery. All unplanted material shall be protected at all times from sun and drying winds. Plants that are not planted immediately shall have their root balls well watered and covered with approved mulching materials. No plants shall remain unplanted for longer than 3 days. Plants shall not be bound with wire or rope at any time so as to damage bark, break branches, or cause any injury.

5. Planting Dates: Unless otherwise specified, planting shall be done after the frost leaves the ground until July 1, and from September 15 to November 1.

6. Maintain at all times during the planting operations one or more stockpiles of approved planting mix.

5. Plant pits to be excavated with vertical sides. Holes for trees to be at least two feet greater in diameter than the ball and one foot deeper than the ball.

6. Loam, organic material and fertilizer mix for use as planting mix shall be thoroughly premixed in the following proportions unless directed otherwise:

   a. one cubic yard of accepted loam

   b. 2 to 3 cubic feet of well rotted cow manure

   c. 4 cubic feet of sphagnum peat moss

   d. 10 pounds of fertilizer (minimum 35% water insoluble (WIN)

   e. 12 pounds of dolomitic limestone.

7. All plant roots and earth balls must be damp and thoroughly protected from sun and wind from the beginning of the digging operation, during transportation and through final planting. The plants shall be planted in the center of the holes and at the same depth as they previously grew. Remove burlap, rope, from sides and tops of root balls. Do not pull burlap out from under root balls. If a wire basket is present, cut and remove all wire keeping the rootball intact. Cleanly cut off broken or frayed roots. Backfill toposil in layers of not more than 6 inches and water each layer sufficiently before the next layer is placed. Use enough backfill

material to bring the surface to finished grade when settled. Form a saucer around each tree to a height of 4 inches.

8. Shrub, perennial and groundcover beds: Score and spread roots on container grown plants on 4 equal areas on sides of roots/soil, scarify and spread roots on bottom of plant. Dig to a depth of one foot (l') below final grade or as shown on the drawings. Supply sufficient planting soil mix to provide one foot (l') deep beds. Water thoroughly after planting.

D. All plants to be flooded with water twice within the first 24 hours of the time of planting and all plants during the maintenance period to be watered at least twice each week. At each watering the soil around each tree or shrub to be thoroughly saturated. If sufficient moisture is retained in the soil, as determined by the Owners Representative, the required watering may be reduced. Trees will require a minimum of ten gallons of water each.

E. Mulch material to be placed over entire saucer areas of individual trees to a depth of two inches, not later than one week after planting. No mulch shall be placed within 2" of the trunk. No mulch to be applied prior to the first watering of plant materials.

F. Pruning: Prune plant material after the plant has been completely planted. Make all large pruning cuts, 1/2 inch diameter and larger on the trunk and main stem, so as not to interfere with the branch collar. Make all pruning cuts less than 1/4 inch diameter with a sharp pair of hand pruners as close to the main stem as possible without damaging the cambium or bud. Remove all sucker growth, water sprouts, crossing or rubbing branches, dead or dying limbs and tips, broken branches, diseased or insect infested limbs and crotches to prevent storm damage. Questionable weak limb and branch removal that may disfigure the tree or shrub should be left for final approval by the Owners Representative. Pinaceae species transplanted during the candle stage should have candles reduced from 1/2 to 2/3 inch. Treatment of all cuts and wounds with a non-toxic tree wound dressing is optional. Never cut a leader.

G. Apply Anti-desiccant to all plants prior to being dug at the nursery and/or as directed by the Owners Representative once the plants have been delivered to the site.

H. If planting is done after lawn preparation or installation, proper protection of lawn areas shall be provided and any damage resulting from planting operations shall be repaired immediately at no cost to the OWNER.

I. In the event that underground construction work, rock or obstructions are encountered in any plant pit or bed excavation work to be done under this Contract, alternate locations may be selected by the Owners Representative.

J. Absolutely no debris may be left on site. Excavated material shall be removed as directed by the Owners Representative. Repair any damage to the site or structures to restore them to their original condition as directed by the Owners Representative, at no cost to the OWNER.

3.3 FERTILIZATION

A. Initial fertilization to consist of the use of dry fertilizer, water-soluble fertilizer or a combination of both.

B. When not included in the planting mix, dry fertilizer, including fertilizer for acid-loving plants, shall be uniformly spread about the plants at the following rate:

1. Trees: 1-1/2 pounds per inch of caliper.

C. Water-soluble fertilizer to be dissolved in water at 2 times the rate recommended by the manufacturer. The thoroughly mixed solution to be applied at the time of initial planting after the water used for back fill soaking has leached away. Care to be taken to prevent any water from washing plant saucers away either during the original watering or while applying water-soluble fertilizer.

D. The fertilizer solution to be applied at the following rates:

1. Plants above 6 feet and up to 12 feet to receive 12 quarts
2. Plants above 12 feet to receive 16 quarts.

E. Unless otherwise approved, re-fertilization to be by a water-soluble fertilizer applied in conjunction with watering or by itself. No re-fertilization will be allowed between September 20 and plant dormancy and between frozen ground and March 21.

F. All plants to be fertilized at least once between April 1 and October 15 with water-soluble fertilizer mixed and applied as herein specified or as directed when applied with a watering.

G. When the CONTRACTOR’s guarantee period extends Spring to Spring, all plants shall receive an additional application of fertilizer in the spring prior to final acceptance.

3.4 MAINTENANCE

A. Maintenance shall begin immediately after each plant is planted and shall continue in accordance with the following requirements:

1. All plants shall be watered at least twice each week during the maintenance period. At each watering, the soil around each tree or shrub shall be thoroughly saturated. If sufficient moisture is retained in the soil, as directed by the Owners Representative, the required watering may be reduced. Trees will require a minimum of ten gallons of water each.

2. All plants shall remain plumb. Any plants that settle out of plumb shall be promptly reset.

3. Individual plant pits shall be kept free of weeds and mulch and shall be replaced as required to maintain a 2" layer of mulch. Individual pits to be neat in appearance and maintained to the lines originally laid out.

4. Contractor: Replace all plants that die during the maintenance period as directed by the Owners Representative.

5. Acts of vandalism, vehicle accidents or fire, if unrelated to construction operations and which cause damage in excess of five trees in one location, will be reasons for consideration of extra payment for approved replacement. Excessive damage due to heavy insect infestations, if all reasonable precautions are taken by the CONTRACTOR, will also be reason for consideration of extra payment for approved replacements.

6. Spraying for both insect pests and diseases shall be included during the maintenance period as required and as directed by the Owners Representative.

7. The Owners Representative may order or the CONTRACTOR may request the use of a suitable insecticide or fungicide when it is determined that infestations of insects or plant disease require the use of such material. No pesticides, insecticides or fungicides may be used without the expressed written permission of the Owners Representative.

B. All herbicides, insecticides, and fungicides to be applied as prescribed by their manufacturer and in accordance with National Park Service, State of Maine, and any local laws. The CONTRACTOR to either possess from the State of Maine the proper registrations and permits for application of such materials or have the applications made by an approved, qualified firm holding such registrations and permits. Copies of all permits in connection with such materials to be furnished to the Owner. No pesticides, insecticides or fungicides may be used without the expressed written permission of the Owners Representative.

C. Keep clean sidewalks and other paved areas during the planting and maintenance operations.

B. Maintenance shall consist of keeping the plants in a healthy growing condition, including watering, weeding, cultivating, re-mulching, removal of dead material, resetting plants plumb and to proper grades and maintaining the planting saucer.

C. If a substantial number of plants are sickly and dead at the time of inspection for punch-out list items, acceptance will not be granted, and it is the contractor's responsibility for maintenance of all the plants to be extended until replacements are made. All dead and unsatisfactory plants to be promptly removed from the project. Replacements to conform in all respects to the specifications for new plants and to be planted in the same manner.

3.5 STANDARDS FOR COMPLETION

A. Conditions for Completion:

1. Each plant to show at least 90% healthy growth and to have the natural character of a plant of its species in accordance with the American Nurseryman's Association Standards. The plants will be replaced live during the normal planting season, until the plants live through one year. Contractor: Promptly notify the Owners Representative of any removals and/or replacements.

B. Inspection and Completion:

1. Upon request of the Contractor in writing, The Owners Representative to inspect the plant material to determine completion of Contract work. The request must be submitted at least 10 days prior to the anticipated inspection date.

2. If the planting are deemed complete to the Owners Representative, a meeting will be arranged with Contractor and Owner to review the planting work. A final inspection is a part of this meeting to insure completion and any punch list items.

C. Cleanup:

1. Contractor: Following the completion of planting operations, immediately remove from the site all materials and equipment not required for any other planting or maintenance work. Store materials and equipment remaining on site in locations which do not interfere with the Owner's maintenance of completed planting or other construction operations.

2. The Contractor is responsible for keeping all paving, building surfaces, signs, posts, and all site improvements clean during planting operations. Clean up spills etc. immediately. Completion of the Work shall not be granted until this condition is met.

END OF SECTION 32 92 00

SECTION 32 94 00 - TOPSOIL

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. Loam Borrow

B. Related Sections:
1. Division 01 Section 32 13 74 Erosion Control
2. Division 31 Section 31 10 00 Site Clearing
3. Division 31 Section 31 20 00 Earth Moving
4. Division 32 Section 32 92 00 Lawns
5. Division 32 Section 32 94 00 Planting

1.3 ALLOWANCES

A. As described in Division 01 Section 01 21 00.

1.4 DEFINITIONS

A. Applicable specifications and publications, referred to herein, form a part of these Specifications:

1. Standard Specification: The State of Maine Department of Transportation, Standard Specification for Highways Bridges, latest edition.

2. ASTM: American Society of Testing Materials

3. AASHTO: American Association of State Highway and Transportation Officials

4. AAN: American Association of Nurserymen

5. AOAC: Association of Official Agricultural Chemists

1.5 SUBMITTALS

A. As specified in Division 1 Section 01 33 23.

B. Prior to commencing with the Work, submit representative of on-site and imported topsoil samples to Owner for selection and approval as follows. Do not order imported topsoil material until Owner's approval has been obtained. Delivered materials to match the approved samples.

1. On site and Imported topsoil: Provide a one (l) cubic foot representative sample from each proposed source for testing and approval as directed herein. Deliver samples to a State University Agricultural Extension Service or other approved soil testing laboratory prior to any loaming, having testing report sent directly to the Owner, and pay all costs. Report to cover soil textural classification (percentages of sand, silt, and clay) and include additive recommendations.

2. Mechanical and chemical (pH soluble salts) analysis to be by a public extension service agency or a certified private testing laboratory in accordance with the current standards of the "Association of Official Agriculture Chemicals".

3. Report to be submitted at least one month before any spreading of topsoil. Test soil for nitrate nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Alumionum, Magnesium, Manganese, Ferric Iron, Sulfate, Soluble Salts (1:2 soil-water ratio) and show acidity (pH) (1:1 soil water ratio) of the soil.

4. Contractor: Submit proposed source(s) of imported topsoil to the Owner for on-site inspection and approval during the growing season. The topsoil must be in its original location or have been stockpiled for a period of not less than one year for use on this project to be considered for acceptance by the Owner.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store excavated topsoil on site as shown on the Drawings or as directed by the Owner for reuse in final topsoil placement and grading. Do not place topsoil in a frozen, wet or muddy condition.

B. Use all on-site stockpiled topsoil after approved amendments have been incorporated before importing topsoil. Do not deliver or place topsoil in frozen, wet, or muddy condition.

PART 2 - PRODUCTS

2.1 ON-SITE TOPSOIL (Where Applicable)

A. Stripped and stockpiled as specified in Section 31 20 00 Earth Moving. Topsoil to be free from weeds, sod, clods and stones larger than 1 inch, toxic substances, litter, or other deleterious material. Screen on-site topsoil for oversized material removal prior to reuse on the project. Test soil as specified herein and apply and incorporate additives as per results of the soil tests and as

specified herein under Section 2.2 IMPORTED TOPSOIL. Re-test as required and as approved by the Owner.

2.2 IMPORTED TOPSOIL

A. Loam to be a "fine sandy Loam" or a "sandy loam" determined by mechanical analysis and based on the "U.S.D.A. Classification System". Loam to mean that portion or the soil profile defined technically as the "A" horizon by the Soil Science Society of America. It will be of uniform composition, without admixture of subsoil. It will be free of stones greater than one (l) inch, lumps, plants and their roots, debris and other extraneous matter over one (l) inch in diameter or excess quantities of smaller pieces of the same materials as determined by the Owner. It will not contain toxic substances harmful to plant growth. It is to be obtained from naturally well-drained areas which have never been stripped before and have a history of satisfactory vegetative growth.

B. Topsoil: Contain not less than 4% or more than 12% organic matter as determined by the loss of ignition of oven-dried samples. Test samples to be oven-dried to a constant weight at a temperature of 230 degrees F. plus or minus 9 degrees F.

C. Topsoil: Have a true pH value of 6.0 to 7.5. The amount of either sulphur or limestone required to adjust loam to the proper pH range shall be determined by the Owner on the basis of soil tests and as specified herein.

D. Contractor: Make any additions to or amendments of topsoil as required to remedy any deficiencies identified in the testing reports as specified herein and as directed by the Owner at no additional cost to the Owner.

E. Imported Topsoil: Free of non-native seeds.

2.3 POROUS CONCRETE UNIT PAVER SOIL MIXTURE

A. Thoroughly mix topsoil as specified herein with 7/8 inch minus as specified in Section 31 20 00 Earth Moving to the following proportions:

1. 70% inch minus to 30% topsoil. Install as specified in Section 32 14 43 Porous Unit Pavers.

2.4 SOIL ADDITIVES

F. Commercial fertilizer, peat, humus or other additives to be used to counteract soil deficiencies as recommended by the soil analysis and as specified in Division 32 Section 32 93 00 Planting and Division 32 Section 32 92 00 Meadow Turf Grass and Lawns. Topsoil conditions are different between Planting and Meadow Turf Grass and Lawns. Contractor to understand and review with the Owner the different areas for topsoil and their requirements as noted in the subsequent specification sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine site conditions and other conditions affecting performance of the Work. Insure the sub-grade is properly graded and at correct levels prior to spreading of topsoil.

B. Examine specified materials before installation. Reject soil amendments that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected and approved by the Owner.

3.2 PREPARATION OF SUBGRADE

A. After Owner's acceptance of sub-grade work, provide additional grading as maybe necessary to bring the sub-grade to a true, smooth slope parallel and except where otherwise indicated, six (6) inches below grade for all areas to receive topsoil. Furnish and install grade stakes on a 50 ft. grid and sufficiently spaced to insure correct line and grade of sub-grade and finished grade. Scarify compacted sub-grade to a 2 inch depth to bond topsoil to subsoil. Place topsoil to a minimum compacted depth of six inches. Spread evenly, hand raking areas inaccessible to machine grading. Immediately before placing topsoil, rake or otherwise loosen the surface of the sub-grade. In areas that have been severely compacted, as determined by the Owner, scarify to a depth of twelve inches by approved method. Sub-grade shall be inspected and approved by the Owner before placing of topsoil.

3.3 PLACING TOPSOIL

A. After topsoil has been spread, prepare it carefully by scarifying or harrowing and hand raking as determined by the Owner. Remove all large stiff clods, brush, roots, stumps, litter and other foreign material and stones over one inch in diameter and dispose of legally off-site. Topsoiled areas shall also be free of smaller stones in excessive quantities as determined by the Owner. Roll the whole surface with a hand or mechanical roller weighing approximately one hundred pounds per foot of width. During the rolling fill all depressions caused by settlement with additional topsoil and then re-grade and roll until the surface presents a smooth, even and uniform finish and is up to the required grade.

3.3 TOPSOIL ADDITIVES

A. Applying Fertilizers and pH adjustment: Apply no fertilizer or pH adjustment material without Owner's prior consent and testing results as per Division 32 Section 32 93 00 Planting and Division 32 Section 32 92 00 Lawns.

END OF SECTION 32 92 00

SECTION 334200 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. PE pipe and fittings.
2. PVC pipe and fittings.
3. Foundation drains and underdrain
4. Concrete pipe and fittings.
5. Non-pressure transition couplings.
6. Expansion joints.
7. Cleanouts.
8. Manholes.
9. Catch basins.
10. Pipe outlets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins Include plans, elevations, sections, details, frames, covers, and grates.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CORRUGATED-PE PIPE AND FITTINGS

A. Corrugated-PE Drainage Pipe and Fittings NPS 3 to NPS 10 AASHTO M 252, Type S, with smooth waterway for coupling joints.

B. Corrugated-PE Pipe and Fittings NPS 12 to NPS 60 AASHTO M 294, Type S, with smooth waterway for coupling joints.

C. Corrugated-PE Silttight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

D. Corrugated-PE Soiltight Couplings: AASHTO M 294, corrugated, matching pipe and fittings.

2.2 PVC PIPE AND FITTINGS

A. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

B. Polyvinyl Chloride (PVC) Pipe: Pipe and fittings shall comply with ASTM D 3034, rated SDR 35. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 3034 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant. PVC shall not be used for any drainage pipe, which will be permanently exposed to sunlight.

2.3 FOUNDATION DRAINS AND UNDERDRAIN

A. Foundation drains shall be 4" diameter perforated rigid ABS pipe, SDR 33.5. All perimeter drains shall be covered with hay, or if noted, "Trevira" spunbond filter fabric type S115 as supplied by Shurtleff Co. Fabric or hay to be laid 1'0" above top of pipe over 1-1 1/2" fill as shown on drawings. Pipe shall have 5/8" holes and be "underdrain" type pipe.

B. Foundation drain outfalls shall be 4" diameter solid rigid ABS pipe, SDR 23.5, sloped to drain. Stone-in end of drainage pipes with drainage fill material in order to protect pipe from freeze-up but allow drainage.

C. MDOT TYPE B Underdrain shall be 6" diameter perforated rigid pipe, SDR 33.5. All drains shall be covered with "Trevira" spunbond filter fabric type S115 or equal as supplied by Shurtleff Co. Fabric to be laid 12" above top of pipe. Pipe shall have 5/8" holes and be "underdrain" type pipe.

2.4 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.

B. Sleeve Materials:
1. For Concrete Pipes: ASTM C443 rubber.
2. For Cast-Iron Soil Pipes: ASTM C564, 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.

C. Unshielded, Flexible Couplings:
1. 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. 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. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.5 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.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. 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.
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: Individual FRP steps; FRP ladder; 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 of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. 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.

2.6 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 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

3. Riser Sections: 4-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 6- to 9-inch) total thickness, that match 24-inch diameter frame and grate.
8. Steps: Individual FRP steps or FRP ladder 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. Frames and Grates: 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.

C. Frames and Grates: 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.

2.7 PIPE OUTLETS

A. HAND LAID RIPRAP: Shall be placed at ends of culverts, foundation drains, properly graded, and compacted as called for. Riprap shall be approximately true to the required slope line and grade and be uniform in appearance. Hand laid riprap or hand laid riprap face shall be random rubble, hand laid for the full depth in one operation to secure interlocking of all face stones and stones placed as backing.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 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.

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 piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 36- inch minimum cover.
4. Install PE corrugated sewer piping in accordance with ASTM D2321.
5. Install PVC sewer piping in accordance with ASTM D2321 and ASTM F1668.

3.3 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 corrugated sewer piping in accordance with ASTM D2321 for elastomeric-seal joints.
3. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 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 **3** inches above finished surface elsewhere unless otherwise indicated.

3.5 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.6 CONNECTIONS

A. Refer to local utility for specific connection details. In the absence of such refer to the following:

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. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. 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.

3.7 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. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

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. Remove top of manhole or structure down to at least 36 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."

3.8 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 nonferrous piping and over edges of underground structures.

3.9 FIELD QUALITY CONTROL

A. 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 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.

B. Leaks and loss in test pressure constitute defects that must be repaired.

C. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.10 CLEANING

A. Upon completion of catch basin installation, each structure shall be cleaned of any accumulation of silt, debris, or foreign matter of any kind and shall be kept clear of such accumulation until final acceptance of the work.

B. Any pipe which is not in true alignment, or which shows any undue settlement after being laid shall be taken up and relaid.

C. Prior to placing the backfill, damaged areas of coupling bands and pipe shall be repaired with the type of coating used on the original pipe. Pipe on which the coating has been damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced without additional cost to the Owner.

END OF SECTION 334200