

PROJECT MANUAL FOR
MCJA -BUILDING C LIMITED RENOVATIONS

**15 OAK GROVE RD
VASSALBORO, ME 04989**

ISSUED FOR BID

APRIL 8, 2025

ARCHITECT

Simons Architects
75 York Street
Portland, ME 04101

**MCJA BUILDING C LIMITED RENOVATIONS
VASSALBORO, ME
ISSUED FOR BID
APRIL 8, 2025**

DOCUMENT 000103 – PROJECT DIRECTORY

OWNER:

Maine Criminal Justice Academy
15 Oak Grove Rd
Vassalboro, ME 04989
Jack Peck, Director
Jack.d.peck@maine.gov

ARCHITECTS:

Simons Architects
75 York Street
Portland, ME 04101
207.772.4656.
Ryan Kanteres, AIA
ryan@simonsarchitects.com
Pat Barendt, AIA
pat@simonsarchitects.com

**STRUCTURAL ENGINEERING,
MEP/FP ENGINEERING**

Allied Engineering – a Salas O’Brien Company
160 Veranda St.
Portland, ME 04103
207.221.2260
Anthony Davis, P.E., LEED AP
Anthony.davis@salasobrien.com
Kenneth Coley, P.E.
kenneth.coley@salasobrien.com
Geoff Chartier
jeff.chartier@salasobrien.com
James Fox, P.E.
James.fox@salasobrien.com

**MCJA BUILDING C LIMITED RENOVATIONS
VASSALBORO, ME
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Notice to Contractors

MCJA – BUILDING C LIMITED RENOVATIONS

BGS project 3695

Brief Project Description: Renovation of floors 2, 3, and 4 At MCJA Building C. Existing dormitory spaces on floor 2 will receive new mechanical systems and refreshed finishes; spatial relationships will remain as existing. Existing dormitory spaces on floors 3 and 4 will be reconfigured with new walls, new restrooms, and new MEP systems. Total Project Area exclusive of exterior walls is 11,095 GSF.

The contract shall designate the Substantial Completion Date on or before *30 January 2026*, and the Contract Final Completion Date on or before *1 March 2026*.

1. Submit bids on a completed Contractor Bid Form (section 00 41 13), provided in the Bid Documents, include bid security when required, and scan each item as an attachment to an email addressed to: BGS.Architect@Maine.gov, so as to be received no later than **1:30:00 p.m. on 9 May 2025**. The email subject line shall be marked "**Bid for MCJA - Building C Limited Renovations**".

Bid submissions will be opened and read aloud at **2:00 p.m.** on the date noted above at the Bureau of General Services office, accessible as a video conference call. Those who wish to participate in the call must submit a request for access to BGS.Architect@Maine.gov.

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

2. Questions and comments on the *bid opening process* shall be addressed to: Division of Planning, Design & Construction, Bureau of General Services, 77 State House Station, Augusta, Maine 04333-0077, BGS.Architect@Maine.gov.
3. Questions and comments regarding the *project* design specifications or drawings shall be directed in writing to the Consultant during the bid period prior to the question and comment deadline of 12:00 p.m. on *1 May 2025*.

Simons Architects
Ryan Kanteres, AIA
ryan@simonsarchitects.com
Pat Barendt, AIA
pat@simonsarchitects.com

4. ☒ Bid security is required on this project.
The Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with the completed bid form submitted to the Owner. The Bid Bond form is available on the BGS website.
or
☐ Bid security is not required on this project.

00 11 13
Notice to Contractors

5. ☒ Performance and Payment Bonds are required on this project.
If noted above as required, or if any combination of Base Bid and Alternate Bids amounts selected in the award of the contract exceeds \$125,000.00, the selected Contractor shall furnish a 100% contract Performance Bond (section 00 61 13.13) and a 100% contract Payment Bond (section 00 61 13.16) in the contract amount to cover the execution of the Work. Bond forms are available on the BGS website.
or
☐ Performance and Payment Bonds are not required on this project.
6. Filed Sub-bids *are not required* on this project.
7. ☐ Pre-qualified General Contractors are utilized on this project.
insert the company name, city and state for each
or
☒ Pre-qualified General Contractors are not utilized on this project.
8. ☒ An on-site pre-bid conference (☒ *mandatory* or ☐ *optional*) will be conducted for this project. The pre-bid conference is intended for General Contractors. Subcontractors and suppliers are welcome to attend. Contractors who arrive late or leave early for a mandatory meeting may be prohibited from participating in this meeting and bidding.
23 April 2025 at 10:00am
MCJA Building C
Site-walk of existing building
or
☐ An on-site pre-bid conference will not be conducted for this project.
9. Bid Documents - full sets only - will be available *upon inquiry* and may be obtained *at market rate cost* from:
Xpress Copy Services
17 Westfield St
Portland, ME 04102
(207) 775-2444
10. Bid Documents may be examined at:
AGC Maine
188 Whitten Road, Augusta, ME 04330
207-622-4741
Construction Summary
734 Chestnut Street, Manchester, NH 03104
603-627-8856

00 21 13
Instructions to Bidders

1. Bidder Requirements

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

00 21 13
Instructions to Bidders

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

00 21 13
Instructions to Bidders

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

**MCJA BUILDING C LIMITED RENOVATIONS
VASSALBORO, ME
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APRIL 8, 2025**

DOCUMENT 003126 – INFORMATION AVAILABLE TO BIDDERS

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 lead and asbestos report for 2nd Floor Building “C”.prepared by EMSL Analytical, Inc., dated 4/17/2015, attached.

END OF DOCUMENT



STATE OF MAINE
BUREAU OF GENERAL SERVICES
SAFETY & ENVIRONMENTAL SERVICES
4TH FLOOR, BURTON M. CROSS BUILDING
77 STATE HOUSE STATION
AUGUSTA, ME 04333-0077

PAUL R. LEPAGE
GOVERNOR

RICHARD ROSEN
COMMISSIONER

EDWARD A DAHL
DIRECTOR

TO: DICK GATES, RICK DESJARDINS

FROM: LARRY MARE

DATE: 4-21-15

SUBJECT: ASBESTOS AND LEAD TEST, 2ND FLOOR BUILDING C

GENTLEMEN:

ON FRIDAY (4-17-15) I CONDUCTED A LEAD AND ASBESTOS TEST ON AN UNFINISHED AREA OF THE 2ND FLOOR OF THE C BUILDING AT THE MAINE CRIMINAL JUSTICE ACADEMY LOCATED IN VASSALBORO, ME.

THE LEAD TEST WAS DONE WITH AN XRF GUN THAT DETERMINES THE PRESENCE OF LEAD IN LAYERS OF PAINT. NO LEAD WAS FOUND IN ANY OF THE BUILDING COMPONENTS IN THIS AREA. THE PAINT IS IN POOR CONDITION AND CAN BE REMOVED AND REPAINTED UNDER NORMAL WORKING CONDITIONS.

ASBESTOS SAMPLES WERE TAKEN OF THE CEILING AND WALL PLASTERS AND SHEET FLOORING IN WHICH THE LAB REPORTED THAT THERE WAS NONE DETECTED

ANY RENOVATION PROJECTS CAN BE DONE UNDER REGULAR ACTIVITIES WITH NO LEAD OR ASBESTOS ISSUES.

ATTACHED IS THE RESULTS OF THE LEAD AND ASBESTOS TESTING.

PLEASE CALL OR EMAIL IF THERE ARE ANY FURTHER QUESTIONS.

THANK YOU.

LARRY MARE, ENGINEERING TECHNICIAN IV

SAFETY & ENVIRONMENTAL SERVICES

77 SHS, AUGUSTA, ME 04333

LARRY.MARE@MAINE.GOV

PHONE: 207-6224-7355

Lead Test Sheet

Place:Maine Criminal Justice Academy

Date:4-17-15

Time:10:30 am

Location	Component	Results (mg/cm2)	Paint Condition
2 nd floor south end	Walls	0.0	Poor
	Window & trim	0.0	Poor
	Doors & trim	0.0	Poor
	Ceilings	0.0	Poor
	Floors	0.0	Poor

1.0 mg/cm2 or greater is considered lead based paint

Certified Tester: Larry Mare

Testing method: XRF gun

1st Pre-Calibration reading: 9.9 (lead NIST) 0.2 (non-lead NIST)

2nd Pre-Calibration reading: 9.9 (lead NIST) 0.1(non-lead NIST)

3rd Pre-Calibration reading: 9.9 (lead NIST) 0.1 (non-lead NIST)

1st Post Calibration: 9.9 (lead NIST) 0.1 (non-lead NIST)

2nd Post Calibration: 9.9 (lead NIST) 0.2 (non-lead NIST)

3rd Post Calibration: 9.9 (lead NIST) 0.2 (non-lead NIST)



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: 621500626
Customer ID: SOME26
Customer PO:
Project ID:

Attn: Larry Mare
State of ME Planning Design & Const Div
111 Sewall Street
77 SHS
Augusta, ME 04333

Phone: (207) 624-7355
Fax:
Collected: 4/17/2015
Received: 4/17/2015
Analyzed: 4/20/2015

Proj: MCJA

Summary Test Report for Asbestos Analysis of Bulk Material via EPA 600/R-93/116 Method via Polarized Light Microscopy

Client Sample ID: 1 Lab Sample ID: 621500626-0001

Sample Description: Room #9/Sheet Flooring

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/20/2015	Brown	0.0%	100%	None Detected	

Client Sample ID: 2 Lab Sample ID: 621500626-0002

Sample Description: Room #7/Wall Surface

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/20/2015	Gray	0%	100%	None Detected	

Client Sample ID: 3 Lab Sample ID: 621500626-0003

Sample Description: Room #12/Wall Surface

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/20/2015	Gray	0%	100%	None Detected	

Client Sample ID: 4 Lab Sample ID: 621500626-0004

Sample Description: Hall/Wall Surface

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/20/2015	Gray	0%	100%	None Detected	

PLM: ME CERT.# BA-0166 (DL)

PLM EPA NOB: ME CERT.# BA-0166 (DL)

Analyst(s):

Desiree Lunt PLM (3)
PLM Grav. Reduction (1)

Reviewed and approved by:

Christina Walker, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. This test report must not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. EMSL bears no responsibility for sample collection activities or analytical method limitations. The laboratory is not responsible for the accuracy of results when requested to physically separate and analyze layered samples. PLM alone is not consistently reliable in detecting asbestos in floor coverings and similar NOBs

Samples analyzed by EMSL Analytical, Inc. South Portland, ME NVLAP Lab Code 500094-0

Initial report from: 04/20/2015 07:57:27

00 41 13
Contractor Bid Form

MCJA – BUILDING C LIMITED RENOVATIONS BGS project number

Bid Form submitted by: <Bid Administrator to select...>

Bid Administrator:

insert name of person receiving bids

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 *insert project name* Project Manual dated *insert date of documents*, prepared by *insert name of Consultant*, 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 *<Bid Administrator to select...>* on this project.

<Bid Administrator to select...>

insert brief name of Allowance

\$ 0.00

3. Alternate Bids *<Bid Administrator to select...>* on this project.

<Bid Administrator to select...>

Any dollar amount line below that is left blank by the Bidder shall be read as a bid of **\$0.00**.

1 insert title of Alternate or "not used"

\$ _____ .00

2 insert title of Alternate or "not used"

\$ _____ .00

3 insert title of Alternate or "not used"

\$ _____ .00

4 insert title of Alternate or "not used"

\$ _____ .00

4. Bid security *<Bid Administrator to select...>* 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 *<Bid Administrator to select...>* on this project.

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

00 43 13
Contractor Bid Bond

Bond No.: insert bond number

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

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

Now therefore:

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

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

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

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

00 43 13
Contractor Bid Bond

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

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the 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.

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

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 _____.

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.

ARTICLE 5 OWNER'S RESPONSIBILITIES

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

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

ARTICLE 6 INSTRUMENTS OF SERVICE

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

ARTICLE 7 MISCELLANEOUS PROVISIONS

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

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

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

ARTICLE 8 CONTRACT DOCUMENTS

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

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

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

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

BGS Project No.: _____

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:	
_____ <i>Signature Date</i> <i>insert name</i>		_____ <i>Signature Date</i> <i>John Kenney, P.E.</i>	
<i>Project Manager/ Contract Administrator</i>		<i>Director, Planning Design and Construction Division (PDCD)</i>	

00 61 13.13
Contractor Performance Bond

Bond No.: insert bond number

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

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

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

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

00 61 13.13
Contractor Performance Bond

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

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

Contractor

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

Surety

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

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

00 61 13.16
Contractor Payment Bond

Bond No.: insert bond number

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

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

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

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

00 61 13.16
Contractor Payment Bond

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

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

Contractor

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

Surety

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

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

State of Maine
CONSTRUCTION CONTRACT
Application for Payment

Project name
 location / school / campus

Application Number: **1**

Contractor Company name
 address
 city state zip code

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)

Type firm 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 / other - clear this text if not used

Type entity name here
 Type person's name, title here

 signature

 date

Bureau of General Services

Type person's name, title here

 signature

 date

State of Maine
CONSTRUCTION CONTRACT
Application for Payment - Continuation Sheet

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

Project name

Contractor Company name

page 1
of 2

[illegible]

State of Maine
CONSTRUCTION CONTRACT
Construction Change Directive

Project name
 location / school / campus

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) 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 General Services
 Division of Planning, Design & Construction
 Type person's name, title here

 signature date

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

BGS Project No.:

n

city state zip code

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
General Services

Division of Planning, Design & Construction

Type person's name, title here

signature

date

00 71 00
Definitions

1. Definitions

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

00 71 00
Definitions

- 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*.

00 71 00
Definitions

- 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

00 71 00
Definitions

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

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

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

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

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

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

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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)

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.

2025 Fair Minimum Wage Rates – Building 2 Kennebec County (other than 1 or 2 family homes)

Occupational Title	Minimum Wage	Minimum Benefit	Total
Brickmasons And Blockmasons	\$42.55	\$28.02	\$70.57
Bulldozer Operator	\$34.44	\$2.26	\$36.70
Carpenter	\$32.59	\$11.94	\$44.53
Cement Masons And Concrete Finisher	\$26.50	\$0.00	\$26.50
Construction And Maintenance Painters	\$28.00	\$1.53	\$29.53
Construction Laborer	\$24.00	\$1.80	\$25.80
Crane And Tower Operators	\$37.50	\$11.94	\$49.44
Crushing Grinding And Polishing Machine Operators	\$27.50	\$5.64	\$33.14
Earth Drillers - Except Oil And Gas	\$22.05	\$1.19	\$23.24
Electrical Power - Line Installer And Repairers	\$43.26	\$16.55	\$59.81
Electricians	\$34.70	\$10.93	\$45.63
Elevator Installers And Repairers	\$71.21	\$43.75	\$114.96
Excavator Operator	\$32.00	\$5.91	\$37.91
Fence Erectors	\$26.00	\$2.63	\$28.63
Flaggers	\$20.50	\$0.40	\$20.90
Floor Layers - Except Carpet/Wood/Hard Tiles	\$26.50	\$3.83	\$30.33
Glaziers	\$46.26	\$22.61	\$68.87
Grader/Scraper Operator	\$31.00	\$6.86	\$37.86
Hazardous Materials Removal Workers	\$21.13	\$1.14	\$22.27
Heating And Air Conditioning And Refrigeration Mechanics And Installers	\$35.00	\$5.56	\$40.56
Heavy And Tractor - Trailer Truck Drivers	\$25.00	\$1.13	\$26.13
Highway Maintenance Workers	\$22.85	\$4.79	\$27.64
Industrial Machinery Mechanics	\$30.00	\$4.60	\$34.60
Industrial Truck And Tractor Operators	\$26.17	\$3.49	\$29.66
Insulation Worker - Mechanical	\$24.00	\$4.71	\$28.71
Ironworker - Ornamental	\$31.37	\$25.82	\$57.19
Light Truck Or Delivery Services Drivers	\$27.99	\$1.97	\$29.96
Loading Machine And Dragline Operators	\$25.50	\$4.99	\$30.49
Millwrights	\$35.95	\$13.84	\$49.79
Mobile Heavy Equipment Mechanics - Except Engines	\$30.00	\$5.67	\$35.67
Operating Engineers And Other Equipment Operators	\$28.50	\$3.54	\$32.04
Paving Surfacing And Tamping Equipment Operators	\$28.60	\$12.03	\$40.63
Pile-Driver Operators	\$36.00	\$2.87	\$38.87
Pipe/Steam/Sprinkler Fitter	\$30.75	\$7.19	\$37.94
Pipelayers	\$27.48	\$4.72	\$32.20
Plumbers	\$34.50	\$5.74	\$40.24
Pump Operators - Except Wellhead Pumpers	\$56.03	\$34.76	\$90.79
Radio Cellular And Tower Equipment Installers	\$30.00	\$4.85	\$34.85
Reinforcing Iron And Rebar Workers	\$56.69	\$2.27	\$58.96
Riggers	\$30.50	\$8.25	\$38.75
Roofers	\$24.67	\$3.60	\$28.27
Sheet Metal Workers	\$28.46	\$6.44	\$34.90
Structural Iron And Steel Workers	\$31.37	\$4.16	\$35.53
Tapers	\$29.00	\$2.40	\$31.40
Telecommunications Equipment Installers And Repairers - Except Line Installers	\$30.42	\$9.75	\$40.17
Telecommunications Line Installers And Repairers	\$30.00	\$2.30	\$32.30

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
Wage & Hour Director
Bureau of Labor Standards

Expiration Date: 12-31-2025
Revision Date: 2-3-2025

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SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.

1.2 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.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.3 SUBMITTALS

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

1.4 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.

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1.5 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 taxes, 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.

1.6 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, 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. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

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.

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3.3 SCHEDULE OF ALLOWANCES

Allowance No. 1 – Flush Wood Doors at Second Floor. Furnish and install five (5) new doors and associated hardware to be installed in existing frames. Doors shall be 3'-0" wide by 6'- 8" high, 20 – minute fire rating for smoke, as specified in Section 081410 – Flush Wood Doors, with door hardware similar to Hardware set 1.2 in Section 087100 – Door Hardware.

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SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if 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 alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Individual Specification Sections reference items included as part of alternates and contain requirements for materials necessary to achieve the work described under each alternates.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. **Alternate No. 1 - (Deduct)** Delete Type W6 walls from the project. Partial List of Associated Work:
1. Existing exterior walls to remain and be repainted on the interior side of the wall.
 2. Delete new window sills; refinish existing wood window sills.
 3. Reduce Work at window jambs and heads.
 4. Delete ceiling soffit at exterior walls on Floor 3.
 5. Delete adjustment to radiator piping at exterior walls on Floors 3 and 4.
 6. Retain existing wiremold at walls, reconfigure outlets.
 7. Refer to Architectural, Mechanical, Plumbing, and Electrical Drawings for additional information.
- B. **Alternate No. 2 – (Deduct)** Delete heat pumps and corresponding outdoor units from Floor 2 spaces only. Ventilation air to remain as documented.

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit one electronic copy of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination 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 substitution 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 and names and addresses of architects and owners.

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- 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 substitution 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.
- 2. 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.

1.4 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.

PART 2 - PRODUCTS

2.1 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:

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- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Requested substitution provides sustainable design characteristics that specified product provided.
 - 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: Architect will consider requests for substitution if received within 30 days after the Notice of Award.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:
- 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. Requested substitution provides sustainable design characteristics that specified product provided.
 - 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 3 - EXECUTION (Not Used)

END OF SECTION 012500

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue through the Project Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.3 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 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. Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C "Proposal Worksheet Detail".
- B. Contractor-Initiated Work Change 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.

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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.

1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "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 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 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.

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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 012600

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 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 other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. 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, before construction begins.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.

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2. Arrange schedule of values consistent with format of AIA Document G703. Retain option in first subparagraph below where Contractor's ongoing activities related to Project closeout will be a line item subject to Application for Payment approval.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - a. 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.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the last day of the month Retain first "Application for Payment Forms" Paragraph below if using a standard industry form. Revise if Owner uses another form. AIA forms described below are available at

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most AIA Chapter offices. EJCDC Document C-700 is another standard industry form owners often use. Alternate forms may include local construction-industry forms or lending institution's own standard forms.

- D. Application for Payment Forms: Use AIA Document G702-1992 or Form RD 1924-18 as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- F. Transmittal: Submit four 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 entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 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. 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. Submittal schedule (preliminary if not final).
 - 5. List of Contractor's staff assignments.
 - 6. List of Contractor's principal consultants.
 - 7. Copies of building permits.
 - 8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 9. Initial progress report.
 - 10. Report of preconstruction conference.

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11. Certificates of insurance and insurance policies.
- 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.
 2. This application shall reflect Certificates of Partial 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. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706-1994, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A-1994, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707-1994, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Requests for Information (RFIs).
 - 2. Project meetings.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 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, and telephone number 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.

1.4 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.

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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 and activities of other contractors 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.

1.5 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as 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. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

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12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working 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 RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. 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 of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 7 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. Software log with not less than the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect .
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- 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. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

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2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.6 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.
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: 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. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of record documents.
 - l. Use of the premises and existing building.
 - m. Work restrictions.
 - n. Working hours.
 - o. Owner's occupancy requirements.
 - p. Responsibility for temporary facilities and controls.
 - q. Procedures for moisture and mold control.
 - r. Procedures for disruptions and shutdowns.
 - s. Construction waste management and recycling.
 - t. Parking availability.
 - u. Office, work, and storage areas.

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- v. Equipment deliveries and priorities.
 - w. First aid.
 - x. Security.
 - y. Progress cleaning.
 - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires 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 problems.
 - 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.

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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. Progress Meetings: Conduct progress meetings at biweekly intervals.

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 meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. 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 utilization.
 - 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.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

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- 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's construction schedule.
 - 2. Construction schedule updating reports.
 - 3. Daily construction reports.
 - 4. Site condition reports.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
 - 3. Three paper copies, for Owner, Architect and Contractor.

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- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to final completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

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- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 5. Work Stages: Indicate important stages of construction for each major portion of the Work.
 6. Other Constraints: The Contractor, subcontractors and delivery services shall be on be mindful at all times for the safety of the public who will be accessing and occupying the building during construction.
- D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.

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2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.
- E. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule.
- F. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
1. Use Microsoft Project, Procore, other system acceptable to the Owner.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates
- C. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- D. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

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1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

2.3 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events.
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

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1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
- 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.

1.3 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule 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.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.
- B. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - 1. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - 2. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
- C. 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.

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2. Coordinate transmittal of different types of submittals for related parts of the Work 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.
- D. 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.
- E. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - f. Name of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

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- a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- F. Electronic Submittals: Identify and incorporate information in each electronic submittal file 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.
 - a. File name shall use project identifier and Specification Section number. Requirement in first subparagraph below can be performed using PDF publishing software.
 - 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 - 4. Transmittal Form for Electronic Submittals: Use acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Transmittal number, numbered consecutively.
 - p. Submittal and transmittal distribution record.
 - q. Other necessary identification.
 - r. Remarks.
 - 5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- G. Options: Identify options requiring selection by Architect.

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- H. Deviations: Identify deviations from the Contract Documents on submittals.
- I. 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.
- J. 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.
- K. 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.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements:
 - 1. Submit electronic submittals via email as PDF electronic files.
 - a. Architect, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Submittals: Submit each submittal digitally, unless otherwise indicated.
 - 3. Certificates and Certifications Submittals: Provide 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.
 - a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. 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 not suitable 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:

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- 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 showing 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 or concurrent with Samples.
6. Submit Product Data in the following format:
 - a. PDF electronic file.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 24 by 36 inches .
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

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2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, 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 one set of Samples.
 - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least **three** sets that show approximate limits of variations.
- E. 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. Submit product schedule in the following format:
 - a. PDF electronic file.

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- F. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures.
- G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- H. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- I. 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.
- J. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- K. 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.
- L. 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.
- M. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- N. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- O. 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.
- P. 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.
- Q. 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.
- R. Schedule of Tests and Inspections: Comply with requirements specified in Section 014000 "Quality Requirements."

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- S. 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.
- T. 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 primers and substrate preparation needed for adhesion.
- U. 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.
- V. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 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 Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action 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.

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- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- C. 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.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

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SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Basis of Design": Are proprietary products or systems specified to convey the quality standards and design components that have been chosen to meet the design requirements for the specific project conditions. It is not intended to exclude other bidders with equal products or systems. Products or systems meeting the requirements specified, but are not listed in the Construction Documents, may be submitted for approval by the Architect in accordance with Section 012500.
- C. "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.
- D. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."
- E. "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."
- F. "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.
- G. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- H. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- I. "Provide": Furnish and install, complete and ready for the intended use.
- J. "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.
- J. Substantial Completion: The stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use. Minor corrections and repairs that can be performed while the Owner has occupied the building and without undue annoyance to personnel will be acceptable under the definition of Substantial Completion. It shall also

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include major final cleaning required under the Contract, removal of all surplus equipment and material not required for completion or remaining work, and the placement of remaining materials and equipment in convenient locations as approved by the Owner.

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. 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.
- C. 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. COE – Army Corps of Engineers; www.usace.army.mil.
 - 2. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
 - 3. DOC - U.S. Department of Commerce; www.commerce.gov.
 - 4. DOE - U.S. Department of Energy; www.energy.gov.
 - 5. EPA - United States Environmental Protection Agency; www.epa.gov.

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6. FG - Federal Government Publications; www.gpo.gov/fdsys .
7. GPO - U.S. Government Publishing Office; www.gpo.gov.
8. GSA - U.S. General Services Administration; www.gsa.gov.
9. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
10. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
11. NIST - National Institute of Standards and Technology; www.nist.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
14. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
15. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USP - U.S. Pharmacopeial Convention; www.usp.org.
18. USPS - United States Postal Service; www.usps.com.

D. 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. USAB - United States Access Board; www.access-board.gov.
3. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

E. 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. MDEP – State of Maine Environmental Protection.
2. MDOT – State of Maine Department of Transportation.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

Statement of Special Inspections

Project: MCJA – Building C Limited Renovations

Location: Vassalbor, ME

Owner: Maine Criminal Justice Academy

Design Professional in Responsible Charge: Allied Engineering | a Salas O'Brien Company

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to this project as well as the name of the Special Inspection Coordinator and the identity of other approved agencies to be retained for conducting these inspections and tests. This *Statement of Special Inspections* encompass the following disciplines:

☒ Structural ☐ Mechanical/Electrical/Plumbing
☐ Architectural ☐ Other: _____

The Special Inspection Coordinator shall keep records of all inspections and shall furnish inspection reports to the Building Official and the Registered Design Professional in Responsible Charge. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Interim reports shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Certificate of Use and Occupancy.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: Monthly

or ☐ per attached schedule.

Prepared by:

Mark Allyn, PE

(type or print name)

Signature X-X-2025
Date

Design Professional Seal

Owner's Authorization:

Building Official's Acceptance:

Signature Date

Signature Date

Schedule of Inspection and Testing Agencies

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

- | | |
|--|---|
| <input type="checkbox"/> Soils and Foundations | <input type="checkbox"/> Mastic and Intumescent Fire Resistant Coatings |
| <input type="checkbox"/> Cast-in-Place Concrete | <input type="checkbox"/> Wood Construction |
| <input type="checkbox"/> Precast Concrete | <input type="checkbox"/> Exterior Insulation and Finish System (EIFS) |
| <input type="checkbox"/> Masonry | <input type="checkbox"/> Mechanical & Electrical Systems |
| <input checked="" type="checkbox"/> Structural Steel | <input type="checkbox"/> Architectural Systems |
| <input type="checkbox"/> Cold-Formed Steel Framing | <input type="checkbox"/> Other |
| <input type="checkbox"/> Spray Fire Resistant Material | |

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. Special Inspection Coordinator	To be determined	
2. Special Inspector and Testing Agency	To be determined	
3. Inspection and Testing Agency	To be determined - QA/QC Department of AISC-Certified Structural Steel Fabricator	
4. Inspection and Testing Agency		
5. Inspection and Testing Agency		
6. Geotechnical Engineer		

Note: The inspectors and testing agencies shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official, prior to commencing work.

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspection and testing activities are subject to the approval of the Building Official. The credentials of all Inspectors and testing technicians shall be provided if requested.

Key for Minimum Qualifications of Inspection Agents:

When the Registered Design Professional in Responsible Charge deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agency Number* on the Schedule.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.
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International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

Schedule of Special Inspections

Notes:

1. The special inspector and testing agent(s) shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official prior to commencing work. The qualifications of the Special Inspector(s) and/or testing agencies may be subject to the approval of the Building Official and/or the Design Professional.
2. The Special Inspector Coordinator's responsibilities can be carried out by either the Special Inspector and Testing Agent, if qualified, or by a distinct entity. The role of the Special Inspector Coordinator is to track and confirm that all inspections have been completed, maintain a log of inspections and non-compliant items, confirm that all non-compliant items have been resolved and closed, and submit reports to the Building Official and Engineer of Record at the specified intervals.
3. Special Inspections as required by Section 1704 are not required where the fabricator is approved in accordance with IBC Section 1704.2.5.
4. NDT of welds completed in an approved fabricator's shop may be performed by that fabricator when approved by the AHJ. Refer to AISC 360, N7.
5. Continuous Special Inspection is defined in IBC as "The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed". Where continuous inspection is indicated, 100% of the work must be inspected and it must be inspected as the work is being performed.
6. Periodic Special Inspection, as defined in the International Building Code (IBC), refers to the part-time or intermittent oversight of work that necessitates special inspection. This oversight is conducted by an approved special inspector who must be present in the area where the work has been or is being performed, as well as upon its completion. Unless specified otherwise in the Schedule of Special Inspection Services, all aspects of the work must undergo 100% inspection. It is important to note that the term "periodic" does not exempt the requirement for 100% inspection; rather, it signifies that the inspector does not need to be present while the contractor is actively performing the work.

Structural Steel			
Item	Agency # (Qualif.)	Scope	Extent
1. Fabricator Certification	1 PE	Verify that structural steel fabricator is AISC certified. At the completion of fabrication, the approved fabricator shall submit a certificate of compliance to the building official stating that the work was performed in accordance with the approved construction documents.	Periodic
2. Quality Control Procedures	2,3, & 4 AWS/ AISC-SSI ICC-SWSI	<p>Special inspection for structural steel shall be in accordance with the quality control and quality assurance inspection requirements of AISC 360 Chapter N. (2 for work performed in the field; 3 for work performed in the Fabricator's Shop).</p> <p>Special inspection for steel joists shall be in accordance with the Special Inspections requirements of IBC 2015 Section 1705.2.3. (2 for work performed in the field; 4 for work performed in the Fabricator's Shop).</p>	Periodic
3. Material Certification	1 PE 2 AWS/ AISC-SSI ICC-SWSI	Review certified mill test reports for structural steel, high-strength bolts, nuts, and welding electrodes (1 to review certified reports; 2 to review markings in the field/shop).	Periodic
4. Bolting	2 & 3 AWS/ AISC-SSI ICC-SWSI	<p>Inspections prior to bolting shall be in accordance with AISC 360 Chapter N, Table N5.6-1.</p> <p>Inspections during bolting shall be in accordance with AISC 360 Chapter N, Table N5.6-2.</p> <p>Inspections after bolting shall be in accordance with AISC 360 Chapter N, Table N5.6-3.</p> <p>Inspect installation and tightening of high-strength bolts. Verify that splines have separated from tension control bolts. Verify proper tightening sequence. Continuous inspection of bolts in slip-critical connections. Visually inspect 100% of all field installed high-strength bolts for proper installation and connection fit-up. (2 for work performed in the field; 3 for work performed in the Fabricator's Shop).</p>	Periodic

Structural Steel			
Item	Agency # (Qualif.)	Scope	Extent
5. Welding	2 & 3 AWS-CWI ASNT	<p>Inspections prior to welding shall be in accordance with AISC 360 Chapter N, Table N5.4-1.</p> <p>Inspections during welding shall be in accordance with AISC 360 Chapter N, Table N5.4-2.</p> <p>Inspections after welding shall be in accordance with AISC 360 Chapter N, Table N5.4-3.</p> <p>(2): <u>Field Welds</u>: Check welder qualifications. Visually inspect 100 percent of all field welds. Verify size and length of welds. Welds that do not pass visual inspection are to be tested again using either magnetic particle or dye penetration test methods. Witness the welding procedure and perform magnetic particle tests on minimum of 15 percent of field welds, per each type of weld. Witness 100 percent of CJP welds. Inspect pre-heat, post-heat, and surface preparation.</p> <p>(2): <u>Field Complete Joint Penetration Welds (CJP)</u>: Witness the welding procedure on 15 percent of CJP welds. Perform ultrasonic testing (ASTM E 164) on 100 percent of all CJP welds. The Fabricator shall ultrasonic test 100 percent of all CJP welds performed in the Fabricator's shop. Test results shall be provided to the Owner's Testing and Inspection Agency and Special Inspection Coordinator.</p> <p>(3): <u>Shop Welds</u>: Welds completed in the Fabricator's shop shall be inspected by the Fabricator in accordance with AISC Chapter N and the Fabricator's established QC procedures.</p> <p>(2 & 3): <u>Shop Complete Joint Penetration Welds (CJP)</u>: Perform ultrasonic testing (ASTM E 164) on 100 percent of shop CJP welds. The Fabricator shall ultrasonic test 100 percent of all CJP welds performed in the Fabricator's shop. Test results shall be provided to the Owner's Testing and Inspection Agency and Special Inspection Coordinator.</p>	Periodic

Structural Steel			
Item	Agency # (Qualif.)	Scope	Extent
6. Dry-pack non-shrink grout	2 ACI-CFTT ACI-STT	<p>Review material preparation and placement per Manufacturer's requirements.</p> <p>Cast cubes and perform strength tests in conformance with ASTM C-109. Provide one set of six 2"x2" cubes for each 10 cubic feet of grout or fraction thereof for each day's grouting.</p> <p>Review curing and cold/hot weather precautions per Manufacturer's requirements.</p>	Periodic
7. Structural Details	2 AWS/ AISC-SSI	Inspect steel frame for compliance with structural drawings and approved shop drawings.	Periodic
8. Metal Deck	2 AWS-CWI	<p>Inspections shall be in accordance with SDI QA/QC Tables 1.1 through 1.8.</p> <p>Verify deck gage, width, and type. Inspect welding and side-lap fastening of metal floor deck. Inspect deck welding to structure, side lap attachments, perimeter edge fasteners, and pour-stop welds. Check welder qualifications.</p>	Periodic
9. Expansion and Adhesive Anchoring	2 ACI-CCI ICC-RCSI	<p>Confirm installer qualifications: ACI-Certified Adhesive Anchor Installer.</p> <p>Witness initial installations of each type and size of mechanical or adhesive anchor by construction personnel on site. Any change in the anchor product being installed or the personnel performing the installation requires an initial inspection.</p> <p>Witness installation of a minimum of 25 percent of each type of mechanical and adhesive anchor, per Contractor, to verify that the work has been performed, the materials used, and the installation procedures used conform to the construction documents and the Manufacturer's Printed Installation Instructions.</p>	Periodic
10. Field Correction of Fabricated Items	2 AWS/ AISC-SSI	Review documentation of Registered Design Professional approved repair and verify completion of repairs.	Periodic

Structural Steel			
Item	Agency # (Qualif.)	Scope	Extent
11. Special Inspection Coordination	1 PE	Monitor testing lab and field inspection results to ensure conformance with construction documents. Submit progress reports to the Building Official and Engineer of Record at the stated interim report frequency, including a log of all nonconforming items.	

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection at facilities.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect testing agencies, and authorities having jurisdiction.
- B. 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.
- C. 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 Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire prevention program.

1.4 QUALITY ASSURANCE

- A. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

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

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use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Contractor shall set up the field office within the existing building (verify). Coordinate location and utility locations with Owner. Keep office clean and orderly.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations, coordinate location of storage with the Owner.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. 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".

PART 3 - EXECUTION

3.1 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.
- 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.

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3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
- B. Water Service: 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.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Toilets: Use of Owner's existing toilet facilities will not be permitted. Provide temporary toilet facilities.
- D. Heating: Provide temporary heating 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.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- F. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to 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.
 - 2. At field office, 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.
 - 3. Provide project superintendent with cellular telephone or portable two-way radio for use when away from field office.

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3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. 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. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

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

1. Temporary Construction Sign: Provide professionally executed Project identification sign. Coordinate design of sign with Owner and Architect.
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 touchup signs so they are legible at all times.

F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

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. Temporary Use of Permanent Stairs for Construction Operations: The use of two (2) permanent stairs for construction traffic will be provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

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3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other items at Project site and on adjacent properties. Repair damage to existing facilities.
- 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.
- C. 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 work day.
- D. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- E. 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 during building alterations and roof patching.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- F. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 - 2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
 - 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.
- G. 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.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

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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.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.
- C. Partially Enclosed Construction Phase: 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. Discard or replace water-damaged and wet material.
 4. Discard, replace, or clean stored or installed material that begins to grow mold.
 5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: 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. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

3.6 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.

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- 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.
 2. 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 015000

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 2. Section 014200 "References" for applicable industry standards for products specified.
 - 3. Section 017700 "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 indicated otherwise.
- 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.
- 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:

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1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "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 not conspicuous.
 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.
- C. Products with asbestos: Asbestos containing materials are not to be purchased or installed in this project.

1.4 COORDINATION

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

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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.
- D. During the construction process, meet or exceed the following minimum requirements to prevent the growth of mold and bacteria:
 - 1. Keep building materials dry. Wood, porous insulation, paper, fabric, and similar absorptive materials shall be kept dry to prevent the growth of mold and bacteria. Cover these materials to prevent rain damage, and if resting on the ground, use spacers to allow air to circulate between the ground and the materials.
 - 2. Replace water-damaged materials, or dry within 24 hours, due to the possibility of mold and bacterial growth. Materials that are damp or wet for more than 24 hours shall be discarded if evidence of mold occurs.
 - 3. Immediately remove materials showing signs of mold and mildew, including materials with exposed moisture stains, from the site and properly dispose of them. Replace moldy materials with new, undamaged materials.

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4. Require that moisture sensitive materials be delivered dry and protected from the elements.
5. Allow for time in the construction schedule for materials to dry before they are enclosed.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 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.

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5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

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. Comply with requirements in Division 1 Section "Substitution Procedures" for consideration of unknown product.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

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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.
 1. Select products for which sustainable design documentation submittals are available from manufacturer.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation of the Work.
 - 3. Cutting and patching.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 QUALITY ASSURANCE

- A. 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, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural element 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. Retain first subparagraph below if providing a list of structural elements requiring review prior to cutting and patching. Revise to suit Project.
 - 3. 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.
 - 4. 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.

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5. 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: Verify location of utilities and alterations indicated as indicated for new construction.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installers or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before

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fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the existing building conditions. If discrepancies are discovered, notify Architect promptly.

3.4 INSTALLATION

- A. General: 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.
- 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 the best possible results. 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.
- 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: Do not use tools or equipment that produce harmful 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 work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

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- 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.
 - 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. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 CUTTING AND PATCHING

- A. Cutting and Patching, 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: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- 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 prevent 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

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adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. 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.
 5. 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. 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 minimize evidence of patching and refinishing.
 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.
 4. Ceilings: Patch, repair, rehang or replace in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.

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- 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 according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: 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.
- 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 assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 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.

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

END OF SECTION 017300

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SECTION 017329 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including cutting and patching.
- B. Related Sections:
 - 1. Division 02 Section "Selective Demolition" for demolition and removal of selected portions of the building.
 - 2. Division 07 Section "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.3 INFORMATIONAL SUBMITTALS

- A. 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 how long services and systems will be disrupted.

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1.4 QUALITY ASSURANCE

- A. 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, notify Architect of locations and details of cutting and await directions from the Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.5 WARRANTY

- A. 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- 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 the Architect for the visual and functional performance of in-place materials.

CUTTING AND PATCHING

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, 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.
 - 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. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before cutting, patching, or installing products. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

CUTTING AND PATCHING

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- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 CUTTING AND PATCHING

- A. Cutting and Patching, 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.
 - 2. All cutting and patching shall be provided by the General Contractor and not by the mechanical, plumbing, electrical or sprinkler trades. Cutting and patching can be by a specialized subcontractor who is skilled in the material being cut (such as the plasterer for cutting and patching plaster).
- B. Temporary Support: Provide temporary support of work to be cut.
- C. 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.
- D. 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 of Division 01 Section "Summary."
- E. 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.
- F. 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.
 - 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.
 - a. Cutting of any Historic material will be reviewed and approved by qualified tradesperson in advance of the work.
 - 3. Plaster Surfaces: Cutting of plaster shall only be performed by the Contractor with instruction and agreement with the qualified plaster subcontractor in advance of the work.
 - 4. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

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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.
- G. 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. 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 minimize 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. 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.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

END OF SECTION 017329

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SECTION 017700 - 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. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements: Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
 - 1. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.2 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

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1.5 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, final completion construction photographic documentation, 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 where applicable.
 - 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 test/adjust/balance 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 heat and other utilities.
 - 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.

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9. Complete final cleaning requirements, including touchup painting.
10. Touch up 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. Reinspection: 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.

1.6 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings.

B. Inspection: Submit a written request for final inspection to determine acceptance. 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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

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1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated copy.
 - b. PDF electronic file. Architect will return annotated copy.

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- C. 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.

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PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor 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.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment, manholes, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - p. Leave Project clean and ready for occupancy.

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3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

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1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf or post type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 2. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.

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7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

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E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.

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4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.
- C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.

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3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- H. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1.8 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.

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- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 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.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following: (Digital Only)
 - 1. Number of Copies: Submit **one** set of scanned marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record documents.
 - 2) Submit record digital data files.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned set of marked-up Record Documents.
 - 2) Submit PDF electronic files of scanned Record Documents.
 - c. Final Submittal:
 - 1) Submit scanned set of marked-up record documents.
 - 2) Submit record digital data files of record digital data of electronic file plots.
 - 3) Include electronic files of plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

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- C. Record Product Data: 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. Record data as soon as possible after obtaining it.
 - c. Record and check the markup before enclosing concealed installations.
 2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 2. Format: **DWG**, Version **Microsoft Windows** operating system.
 3. Format: Annotated PDF electronic file **with comment function enabled**.
 4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 5. Refer instances of uncertainty to Architect for resolution.
 6. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
- C. 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.

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2. Format: Annotated PDF electronic file.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

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. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as PDF electronic file.

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, scanned PDF electronic file(s) of marked-up paper copy of Product Data. Include a directory for record product organized by specification number and title, electronically linked to each item of the record Product Data.

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2.4 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 scanned PDF electronic file(s) of marked-up 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 017839

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SECTION 024119 - SELECTIVE DEMOLITION

1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused, recycled or turned over to the Owner.
3. Temporary dust and sound partitions.
4. Temporary ventilation.
5. Repair procedures for selective demolition operations.
6. Patching and repairs.
7. Coordination with Owner for renovations adjacent existing occupied spaces.
8. Lead Paint Removal.

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

1.3 INFORMATIONAL SUBMITTALS

- A.** Proposed Dust Control and Noise Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations and proposed time frame for their operation. Indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- B.** Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

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- C. Pre-demolition photographs or video: Submit before Work begins.
- D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.
 - 6. Review requirements to keep existing construction in place to minimize disruption of Owner's operations.

1.5 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. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Lead Paint: It is expected that materials coated with lead paint primer be encountered in the Work.
 - 1. As a minimum, comply with OSHA lead standards 1926.62, State of Maine, federal EPA and local requirements. Firms conducting lead-related tasks affecting lead-based paint shall be EPA lead-Safe Certified for Repair, Renovation and Painting (RRP) for Lead-safe work practices. Provide copies of Lead-Safe Certifications.
 - 2. All penetrations that impact lead paint coated surfaces must be conducted using HEPA filtered hand tools (Drills) equipped with a dust collection shroud equivalent to or similar to Novatek's DDS-1/Dustless Drill Shroud and HEPA Vacuum dust collection system.
 - 3. Lead-containing dust and debris shall be placed in sealed, watertight containers properly labeled as a hazardous waste, and located to a designated location for disposal at the conclusion of each day's work. Lead-based paint waste shall not be stored on site for longer than 30 days. Store, handle, load, transport and dispose of it in accordance with local, state and federal requirements.
- D. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

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- E. 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.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. 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.
- H. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.6 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.

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 ASSE A10.6 and NFPA 241.

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 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

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3.3 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. Arrange to shut off utilities with utility companies.
 - 3. 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.
 - 4. Disconnect, demolish, and remove 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.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 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. Install temporary dust protection barriers to protect existing and finished interior spaces from areas that are under construction. Temporary dust protection barriers specified in Section 015000 Temporary Facilities and Controls. Remove dust partitions when the Work is complete. Repair damage and finish areas to match adjacent construction.
- C. 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.

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- D. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated on the Drawings. 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 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 reinstalled in their original locations after selective demolition operations are complete.

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3.6 CLEANING

- A. Remove demolition waste materials from Project site and recycle or dispose of them
 - 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.
- B. Burning: Do not burn demolished materials.
- C. 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

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SECTION 035413 - GYPSUM CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes gypsum-cement-based, self-leveling underlayment for application below interior floor coverings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.
- B. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

PART 2 - PRODUCTS

2.1 GYPSUM-CEMENT-BASED UNDERLAYMENTS

- A. Underlayment: Ardex; K-15 Self-Leveling Repair Underlayment and LU-100 Self-Leveling Flooring Underlayment Gypsum-cement-based, self-leveling product that can be applied in minimum uniform thickness of 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.
 - 1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F.
- D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
 - 1. Primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
 - 1. Treat nonmoving substrate cracks to prevent cracks from telegraphing (reflecting) through underlayment.
 - 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
 - 1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate as specified by the flooring manufacturer.
- C. Nonporous Substrates: For terrazzo tile substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces.
- D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment.

3.2 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
 - 2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
 - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment to produce uniform, level surface.
 - 1. Apply a final layer without aggregate to product surface.
 - 2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment. Prevent contamination during application and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

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- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

END OF SECTION 035413

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SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural-steel materials.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.4 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Shop drawings shall be reviewed and "checked" by the Fabricator prior to being submitted to the Engineer. Unchecked shop drawings shall be rejected and returned to the contractor.
- C. Contractor to provide a detailed submittal schedule identifying all submittals and the date they are to be received by Allied Engineering | a Salas O'Brien Company. Submittal schedule to be submitted two weeks prior to the start of the submittal process and updated every two weeks.

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D. Applicable shop standards for the following:

1. All gravity connection details with capacities.

E. Sample calculations for the following:

1. Simple shear connections including seated connections and skewed connections shall include checks for bolt shear, block shear, web bearing, shear on net section of connection material, bending on net section of connection material, and weld stress as applicable.
2. Bracing connections including checks for bolt shear, block shear, web bearing, tension yield on gross section of connection material, tension rupture on net section of connection material, compression buckling of gusset plate, and weld stress as applicable.
3. Beam web stiffeners including checks for compression buckling, crippling, sideways web buckling, local web yielding, and local flange bending as applicable.
4. Column web stiffeners including checks for compression buckling, local web yielding, and local flange bending as applicable.
5. Moment connections including checks for weld strength, column web shear, local web yielding, compression web building, web crippling, and local flange bending as applicable.
6. Other design calculations for connections, as requested by the Engineer.
7. The above-referenced standards and calculations must be submitted and approved at least two weeks prior to submitting detailed shop drawings. Shop drawings will not be reviewed until standards and calculations have been approved.

F. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Threaded rods.
4. Galvanized repair paint.

G. Shop Drawings: Show fabrication of structural-steel components.

1. Erection drawing showing weights and locations of all structural steel members shall be submitted for review prior to the submission of detail drawings. These erection drawings shall include large scale sections through all conditions to indicated suspended lintels, braces, and field welding. No detail drawings shall be submitted prior to the review of shop standards and erection drawings.
2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
3. Include embedment Drawings.
4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
6. Indicate working point locations and brace working lines on braced frame beam drawings.

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- H. Fabricator Certificate of Compliance: At the completion of fabrication, the certified fabricator shall submit a Certificate of Compliance to the building official stating that the work was performed in accordance with the approved construction documents.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For firms and persons specified in the "Quality Assurance" article who demonstrated their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Welding certificates.
- C. Mill test reports for structural-steel materials, including chemical and physical properties.
- D. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
- E. Source quality-control reports.
- F. Field quality-control reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU.
- B. Quality control procedures shall be executed in the shop by a qualified AISC certified fabricator in accordance with AISC 360 Chapter N. In addition to the inspection tasks listed within Tables N5.4-1, N5.4-2, and N5.4-3, the fabricator shall include the cost associated with UT testing all shop-performed complete-joint penetration (CJP) groove welds subject to transversely applied tension loading in butt, tee, and corner joints, in material 5/16 inch thick or greater. All NDT reports shall be submitted to the owner's testing agency and EOR for review and record.
- C. Detailer Qualifications: A qualified detailer with a minimum of five years' experience in structural steel detailing of similar projects.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
 - 1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welded processes involved, and if pertinent, has undergone recertification.

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1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Typical Simple Beam and Girder Connections: Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
 - a. Select and complete connections using ANSI/AISC 360.
 - b. Use Allowable Stress Design; data are given at service-load level.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles: ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M or ASTM A572/A572M, Grade 50, if noted.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.

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E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

1. Weight Class: As indicated.
2. Finish: As indicated.

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, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Galvanized Finish: Hot-dip zinc-coating, ASTM A 153. Class C, where indicated. Retap nuts in accordance with ASTM A 385.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Galvanized Finish: Hot-dip zinc-coating, ASTM A 153. Class C, where indicated. Retap nuts in accordance with ASTM A 385.

2.4 RODS

A. Threaded Rods: ASTM F1554.

1. Grade 36 unless otherwise noted.
2. Nuts: ASTM A63 heavy-hex carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain.

2.5 PRIMER

A. Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664.

1. Products: Subject to compliance with requirements, provide the following:
 - a. Tnemec Company, Inc.; Tnemec Series 88HS.
 - b. The Sherwin-Williams Company; Steel Spec Structural Steel Primer.
 - c. Sumter Coatings, Inc.; 99 Series Heavy-Duty Primer.

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- B. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight and complying with DOD-P-21035A or SSPC-Paint 20.

2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Holes: Provide holes required for securing other work to structural steel.
 - 1. Drill or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 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.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

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2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M. All zinc material shall meet the chemical requirements for high-grade zinc according to ASTM B6.
 - 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.

2.9 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.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. 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 2 "Hand Tool Cleaning." Provide where standard shop primer is specified.
- 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. Prepared galvanized-steel surfaces in accordance with primer manufacturer's written instructions and recommendations.
- 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. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.10 SOURCE QUALITY CONTROL

- A. The Fabricator shall include in their Bid the cost associated to perform ultrasonic testing (ASTM E 164) on 100 percent of all full penetration welds (CJP welds) performed in the Fabricator's shop. Test results shall be provided to the Owner's testing agency for review and verification.

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- B. Correct deficiencies in work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before detailing proceeds, verify all existing elevations, locations, and dimensions of existing construction as required.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- C. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- D. Splice members only where indicated and as required to comply with OSHA requirements.
- E. Do not use thermal cutting during erection.
- F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- G. The contractor shall accept full responsibility for design strength, safety, and adequacy of all temporary bracing and sequencing of structural steel erection to brace the structure. Provide all temporary braces, guys, connections, and work platforms required to safely resist all loads, including storms, to which the structure may be subjected.

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- H. The contractor shall guy, plumb, and align framing in accordance with limits defined in the AISC's "Code of Standard Practice."
- I. Any corrections required in the field to make members fit shall be brought to the attention of the engineer for approval.

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. Design and end connections shall be in accordance with the AISC's "Manual of Steel Construction." A minimum of two bolts per member connection is required. Field connections may be bolted using 3/4-inch diameter bolts minimum, except where noted welded.
- C. Beam end connections shall be selected and detailed for 1.25 times the reactions indicated. A minimum connection capacity of 6k shall be provided. Reactions governed by the 6k minimum are designated as such on plans, and need not be increased by the factor of 1.25. For the purpose of bidding only, connections where no end reactions are indicated may be estimated for a reaction equal to one-half the allowable uniform load for the beam span.
- D. Connections shall be consistent with Type 2 construction as described in the AISC Specifications, unless otherwise indicated on the Structural Drawings.
- E. Weld Connections: Comply with AWS D1.1/D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

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3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field inspections and tests and to prepare test reports.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
- C. Additional testing, at contractor's expense, will be performed to determine compliance of correct work with specified requirements.
- D. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
- E. The Fabricator and Erector are to provide the testing and inspection agency and the Special Inspector safe access to the site throughout the duration of the steel erection. The Fabricator is to notify the testing agency and the Special Inspector a minimum of 48 hours prior to the start of erection.
- F. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 051200
DATE

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Miscellaneous steel trim.

B. Products furnished, but not installed, under this Section:

1.2 SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

2.2 FERROUS METALS (Coordinate metal fabrications required to support MEP installations)

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.**
- B. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.**
- C. Stainless Steel Sheet for Exterior wall: 12 gauge protection plates.**
- D. Steel Tubing: ASTM A 500, cold-formed steel tubing.**
- E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.**
- F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M.**

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2.3 NONFERROUS METALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- B. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 at exterior walls.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.

2.5 MISCELLANEOUS MATERIALS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Shop Primers: Provide primers that comply with Section 099100 "Painting."
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply with the following:

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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.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 24 inches (600 mm) o.c.

2.7 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.

2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.9 STEEL AND IRON FINISHES

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
 - b. ICI Devco Coatings; Catha-Coat 313.
 - c. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
 - d. PPG Architectural Finishes, Inc.; Epoxy Zinc Rich Primer 97-670.
 - e. Sherwin-Williams Company (The); Zinc Clad IV, B69A8/B69V8.
 - f. Tnemec Company, Inc.; Theme-Zinc 90-97.

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- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
 - 1. Available Products:
 - a. Sealmastic, Type 1; W. R. Meadows
 - b. Hydrocide 600; Sonneborn Building Products.
 - c. Karnak 100 AF; Karnac Chemical Corp.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
 - 1. Available Products:
 - a. Five Star Grout by Five Star Products, Inc.
 - b. Masterflow 928 Grout by Master Builders Technologies.
 - c. SonogROUT 10K by Sonneborn.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 3, "Power Tool Cleaning." 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 099100 "Painting", "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- 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.
- E. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

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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.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the 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 A 780.

END OF SECTION 055000

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SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

B. Adjust list below to suit Project.

1. Rooftop equipment bases and support curbs, wood blocking used in conjunction with the roof Work.
2. Wood blocking and nailers.
3. Plywood backing panels.
4. Furnish and install solid metal blocking for interior wall mounted counters, cabinets, Owner furnished equipment and accessories, grab bars, and toilet and bath accessories. Coordinate all locations of items with Owner. Coordinate with Section 092216 for metal framing.
5. Exterior grade panel substrate under Toilet Room counters.

1.2 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
2. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.

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2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.
4. Provide kiln dry lumber, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Pressure-Treated Wood: In accordance with AWPAC C2 (lumber) and AWPAC C9 (plywood).
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and the following:
 - a. Copper azole, Type B (CA-B).
 2. Preservative Retention:
 - a. Decking: 0.08 pcf.
 - b. Above Ground: 0.10 pcf.
 - c. Ground or Fresh Water Contact: 0.21 pcf.
 3. Species: Mixed southern pine; SPIB.
 4. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece, or omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat items indicated on Drawings, and the following:
1. Wood nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, and waterproofing.
- E. Product: Acceptable products include but are not limited to the following:
1. Wolmanized Natural Select Wood by Arch Treatment Technologies, Inc.

2.3 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including the following:
1. Rooftop equipment bases support.

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2. Blocking.
3. Nailers.

B. For items of dimension lumber size, provide No. 2 grade lumber, kiln dried and any of the following species:

1. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.

2.5 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4 inch (19 mm) thick. Paint flat black as required by electrical code.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: Hilti Kwik-Flex or Elco Dril-Flex; no substitutes,

1. Plywood sheathing: 10-24 x 1-1/4 inch wafer head #3.
2. 2 x wood blocking: 12-24 x 2-1/2 inch wafer head #3.

F. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

I. Framing Anchors for Terracotta Block to be determined, as needed.

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PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Apply field treatment complying with AWWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. Table 2304.9.1, "Fastening Schedule," in the International Building Code.
- E. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; pre-drill for Lag screws, and as required by fastener manufacturer.
- F. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.

END OF SECTION

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SECTION 062023 - FINISH CARPENTRY AND MILLWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install wood window sills and trim.
- B. Coordinate and verify locations of solid wood or metal blocking for all items, including Owner furnished items, accessories and equipment.
- C. Solid surface countertops, supports and removable front access panel.

1.2 RELATED SECTIONS

- A. Section 012300: Alternates
- B. Section 061000: Rough Carpentry
- C. Section 079200: Joint Sealants
- D. Section 099100: Painting

1.3 SUBMITTALS

- A. Submittals shall be in accordance with Section 013300.
- B. Shop Drawings: Dimensioned Plans, elevations and sections, and details, showing location of each item with verification of finished and materials identifying components used, edgings for wood, solid surfaces, hardware model numbers, size and locations of blocking and indicating method of attachment, including blocking for Owner furnished items.
- C. Submit color sample for verification of solid surface materials selected by Architect.

1.4 QUALITY ASSURANCE

- A. Standard for Materials and Workmanship: Comply with applicable requirements of "Architectural Wood Work Quality Standards," published by Architectural Woodwork Institute (AWI) and conforming to specific materials specified.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver products until ambient conditions required can be and are maintained.
- B. Do not deliver woodwork until wet work, painting, grinding, and similar operations in storage and installation areas which could damage, soil, or deteriorate woodwork have been completed.
- C. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.
- E. Store products only in areas where ambient conditions required can be and are maintained.

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1.6 PROJECT CONDITIONS

- A. Maintain temperature and humidity in storage and installation areas as required to maintain moisture content of installed woodwork within a 1 percent tolerance of the optimum moisture content determined by the fabricator; maintain required conditions from date of delivery through the remainder of the construction period.
- B. Obtain field measurements and verify dimensions before fabricating woodwork.

PART 2 - PRODUCTS

2.1 MATERIALS AND GRADES

- A. Hardwood (for painted windowsills and millwork): Custom Grade Poplar or Birch.
- B. Hardwood Plywood: Custom Grade hardwood veneer.
- C. Exterior Grade Veneer Core Plywood or Marine Grade Medium Density Fiberboard under countertops with sinks.

2.3 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Grade: Premium.
- B. Solid-Surfacing-Material: Dupont Corian, 100 percent acrylic, 1/2 inch thick countertop, with matching back and sidesplashes.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid surfacing material complying with the following requirements:
 - 1. As selected by Architect from manufacturer's full color range.
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate tops with shop-applied edges of materials and configuration indicated.
 - 2. Fabricate tops with shop-applied backsplashes.
- E. Solid Surface Counter Brackets: Rakks EH-LV-Custom, coordinate sizes with counters and enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that site conditions are free of defects or errors which would cause defective installation of woodwork items.
- B. Verify adequacy of blocking and support framing.

3.2 INSTALLATION

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- A. Install wood windows, trim, and solid surface counters, back and side splashes in accordance with AWI Quality Standard 1700, Grade II.
- B. Set and secure woodwork in place; rigid, plumb and level.
- C. Carefully scribe woodwork abutting other components.
Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
- D. Sand and prepare wood window sills for field painting. Refer to Alternate 1.
- E. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes to walls with adhesive.
 - 4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

3.3 CLEANING AND ADJUSTING

- A. Clean woodwork, fittings and fixtures.

END OF SECTION

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mineral-wool blanket.
 - 2. Mineral-wool board.
 - 3. Fiberglass Batts for Acoustics
 - 4. Sprayed Foam (non-expanding) insulations.
 - 5. Smart vapor barrier
- B. Related Requirements:
 - 1. Section 09200: Gypsum Board, for Sound Attenuation Panels

1.2 SUBMITTALS

- A. Product Data: For the following: Submit insulation data as required by Owner.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition. Do not deliver foam-plastic board materials to Project site until just before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.4 PROJECT CONDITIONS

- A. Do not proceed with the installation of insulation on walls or under slabs until the Work which follows (and which conceals the insulation) is ready to be performed.
- B. Examination of Substrate: Examine the substrate and the conditions under which the insulation Work is to be performed. Do not proceed with the insulation Work until unsatisfactory conditions have been corrected.

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PART 2 - PRODUCTS

2.1 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket Insulation, Batts Unfaced: ASTM C665, Type IA (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved substitute:
 - a. Rockwool; Comfortbatt.
 - b. Thermafiber Inc.; an Owens Corning Company; Ultrabatt Insulation.
 - 2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 - 3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
 - 4. R-Value: 4.2 per inch of thickness.
 - 5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.2 MINERAL-WOOL BOARDS

- A. Mineral-Wool Board Insulation, Unfaced: ASTM C612, Type IVB; passing ASTM E136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved substitute:
 - a. Rockwool; Comfortboard 80.
 - 2. Actual Density: 8.0 lb/cu. ft..
 - 3. Flame-Spread Index: 0 when tested in accordance with ASTM E84 (UL 723).
 - 4. Smoke-Developed Index: zero when tested in accordance with ASTM E84 (UL723).
 - 5. R-Value: 4.2 per inch of thickness.
 - 6. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
 - 7.

2.3 SPRAYED FOAM INSULATION

- A. Sprayed Polyurethane Foam Sealant for Perimeter of Doors and Windows: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
 - 1. Products:
 - a. Great Stuff Insulating Foam Sealant; a DuPont company; Window and Door Insulating Foam Sealant.
 - b. Great Stuff Insulating Foam Sealant; a DuPont company; Froth-Pak Foam Sealant.
 - c. Zerodraft; Zerodraft Insulating Air Sealant.
- B. Protective Coatings:
 - 1. Flame-Resistive Coating for Exposed Foamed-in-Place Insulation: Provide one of the following products approved by the Authority Having Jurisdiction and compatible with spray foam product:
 - a. Cafco: TB-415.

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- b. Cafco: TB-15.
- c. Flame Seal TB.
- d. International Fireproof Technology, Inc.: DC315.
- e. TPR2: Fireshell F10E.
- f. TPR2: Fireshell F1E.
- g. No-Burn Plus ThB Thermal Barrier.

2.4 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 - 1. Manufacturers: 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. AGM Industries, Inc.
 - b. Gemco.
 - 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.
 - 4. Washer: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
 - 5. Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.5 VAPOR BARRIER, SMART

- A. Vapor Retarder (Smart): Certainteed Membrain Smart vapor Retarder or ProClima Intello Plus, for use with unfaced, vapor permeable insulation in wall and ceiling cavities. Material has a permeance of 1 perm or less when tested to ASTM E 86, dry cup method and increases to greater than 10 perms using the wet cup method.
 - 1. Water Vapor Permeance:
 - a. ASTM E 86, dry cup method: 1.0 perms.
 - b. ASTM E 86, wet cup method: 10.0 perms.
 - 2. Fire Hazard Classification: ASTM E 84:
 - a. Maximum Flame Spread Index; 20.
 - b. Maximum Smoke Developed Index; 55.

Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder. Install insulation with vapor barrier installed facing the warm side of walls.

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PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 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, unless Installer's Certification is provided.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF 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. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Sprayed Foam Insulation: Comply with insulation manufacturer's written instructions applicable to products and applications. Spray insulation to envelop around doors, windows and penetrations to be insulated and fill voids. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam. Install into cavities formed by framing members to achieve thickness indicated on Drawings.
 - 1. At Locations Exposed To View: Apply Flame-Resistive Coating in accordance with manufacturer's recommendations.

3.4 RIGID INSULATION SUPPORT

- A. Install between metal stud supports, specified in Section 091116, in strict accordance with manufacturer's instructions.

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SECTION 075323 - MEMBRANE ROOF ALTERATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Alterations to existing (EPDM) sheet roofing adhered system.
- B. Roof Insulation, as needed.
- C. Flashings for new rooftop units and equipment.
- D. Roof vent pipe stack flashing boots
- E. Roof Walkway Pads

1.2 RELATED WORK

- A. Section 061000, Rough Carpentry: for treated wood framing, blocking, and nailers:.
- B. Section 076200, Flashing and Sheet Metal: for flashings and caps.
- C. Mechanical curbs and equipment supports.

1.3 QUALITY ASSURANCE

- A. Approved applicator by the membrane roofing system manufacturer, and certified by the manufacturer as having the necessary expertise to install alterations and not void the warranty of the existing roof system.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Flashings and termination details, as needed.
- B. Manufacturers installation instructions for project alterations.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle materials as specified by manufacturer.
- B. Store volatile materials separate from other materials with separation to prevent fire from damaging the work, or other materials.

1.6 WARRANTY

- A. Maintain the existing roof system warranty. Provide a warranty for the alteration work.

PART 2 - PRODUCTS

2.1 EPDM SHEET ROOFING

- A. The existing EPDM roof system is believed to be a 60 mil Carlisle membrane, installed in 2000.
- B. EPDM Membrane: Use 0.060-inch thick sheet for patching membrane of existing adhered system.

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2.2 EPDM FLASHING SHEET

- A. Conform to ASTM D4637, Type I, Grade 1, Class U, unreinforced, color, same as roof membrane modified as specified for flashing.
- B. Self curing EPDM flashing, adaptable to irregular shapes and surfaces. Minimum thickness 0.060-inch.
- C. Vent pipe flashing: (add)

2.3 MISCELLANEOUS ROOFING MEMBRANE MATERIALS

- A. Sheet roofing manufacturers specified products.
- B. Splice Adhesive: For roofing and flashing sheet.
- C. Lap Sealant: Liquid EPDM rubber for roofing sheet exposed lap edge.
- D. Bonding Adhesives: Neoprene, compatible with roofing membrane, flashing membrane, insulation, metals, concrete, and masonry for bonding roofing and flashing sheet to substrate.
- E. Fastener Sealer: One part elastomeric adhesive sealant.
- F. Temporary Closure Sealers (Night Sealant): Polyurethane two part sealer.
- G. Primers, Splice Tapes, Cleaners, and Butyl Rubber Seals: As specified by roof membrane manufacturer.
- H. Asphalt Roof Cement: ASTM D4586.

2.4 ROOF INSULATION

- A. Roof and Tapered Insulation: Match any existing insulation required for alterations.

2.5 FASTENERS

- A. Fasteners: Fluoropolymer coated, corrosion resistant screw fasteners with stress plates, approved for use by membrane manufacturer.
- B. Exhaust Vent Flashing

2.6 PREFORMED FLASHING SLEEVES

- A. Vent Stack Flashing: Metal flashing sleeve or boot, uninsulated, with integral deck flange, sized to fit pipe. Roof flashing as recommended by membrane manufacturer.
- B. Exhaust Vent Flashing: Coordinate flashings with Mechanical Work.

2.7 WALKWAYS

- C. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.
 - 1. Size: Approximately 36 by 60 inches, in configuration shown on drawings.
 - 2. Color: Contrasting with roof membrane.

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PART 3 – INSTALLATION

3.1 INSTALLATION OF ROOFING AND FLASHING FOR ALTERATIONS

- A. Do not allow the membrane to come in contact with surfaces contaminated with asphalt, coal tar, oil, grease, or other substances which are not compatible with EPDM roofing membrane.
- B. Adhered System patching:
 - 1. Apply bonding adhesive in quantities required by roof membrane manufacturer.
 - 2. Fold sheet back on itself, clean and coat the bottom side of the membrane and the top of the deck with adhesive. Do not coat the lap joint area.
 - 3. After adhesive has set according to adhesive manufacturer's application instruction, roll the membrane into the adhesive in manner that minimizes voids and wrinkles.
 - 4. Repeat for other half of sheet. Cut voids and wrinkles to lay flat and clean for repair patch over cut area.
- C. Install flashings (same day). If the flashing cannot be completely installed in one day, complete the installation until the flashing is in a watertight condition and provide temporary covers or seals
- D. Installing EPDM Base Flashing
 - 1. Install EPDM flashing membranes to wall to a height not less than 8 inches above roof surfaces and 4 inches on roof membranes. Install in accordance with NRCA manual:
 - a. Adhere flashing to wall with bonding adhesive.
 - b. Form inside and outside corners of EPDM flashing membrane in accordance with NRCA manual (latest edition). Form pipe flashing in accordance with NRCA manual.
 - c. Lap ends not less than 4 inches.
 - d. Adhesively splice flashing membranes together and flashing membranes to roof membranes. Finish exposed edges with sealant as specified.
 - 2. Apply sealant to top edge of flashing.

3.2 TEMPORARY ROOF

- A. Install temporary roof when sequences of work or weather does not permit installation of a completed permanent roof system or roof would be subject to phasing of roof work, construction traffic, scaffolds, and work over roof area.

END OF SECTION

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SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Firestopping materials.
- B. Firestopping of all penetrations and interruptions to fire rated assemblies, whether indicated on drawings or not.
- C. Firestopping for ductwork specified in Mechanical sections.

1.2 RELATED SECTIONS

- A. Section 09200 - Gypsum Board: Gypsum Wallboard.
- B. Division 23 for Mechanical ductwork and penetrations.

1.3 REFERENCES

- A. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2002.
- B. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- C. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- D. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration and UL assembly.
- C. Product Data: Provide data on product characteristics.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs which provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
 - 2. Current evaluation reports published by CABO, ICBO, or BOCA will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Approved by firestopping manufacturer.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions

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during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

PART 2 PRODUCTS

2.1 FIRESTOPPING ASSEMBLIES

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use any system listed by UL or tested in accordance with ASTM E 814 that has F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and that meets all other specified requirements.
 - 2. Fire Ratings: See Drawings for required systems and ratings.
- B. Firestopping Between Edge of Floor Slab: Mineral fiber safing insulation.

2.2 MATERIALS

- A. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant; conforming to the following:
 - 1. Movement Capability: ASTM C719 \pm 50%.
 - 2. Stress: 1/2" x 1/2" Bead 35 lbs/in. at 50% Extension.
 - 3. Hardness Shore: 25 per ASTM D 2240.
 - 4. Tensile Strength: 270 per ASTM D412.
 - 5. Sag: Non-slump.
 - 6. Flame Spread/Smoke Development: 5/45 per ASTM E 84.
 - 7. Durability and Longevity: Permanent.
 - 8. Color: Light gray.
 - 9. Manufacturers:
 - a. A/D Fire Protection Systems Inc: www.adfire.com.
 - b. 3M Fire Protection Products: www.3m.com/firestop.
 - c. Specified Technologies, Inc: www.stifirestop.com.
 - d. Substitutions: See Section 016000 - Product Requirements.
- B. Foam Firestoppping: Multiple component foam compound; conforming to the following:
 - 1. Density: 14-18 lb/cu ft.
 - 2. Cellular Structure: Approximately 50% Closed Cell.
 - 3. Oxygen Index: 28 Minimum.
 - 4. Durability and Longevity: Permanent.
 - 5. Color: Black.
 - 6. Manufacturers:
 - a. 3M Fire Protection Products: www.3m.com/firestop.
 - b. Specified Technologies, Inc: www.stifirestop.com.
 - c. Substitutions: See Section 016000 - Product Requirements.
- C. Fiber Packing Material/Fire Safing Insulation: Manufactured from basaltic mineral wool, with fibers bonded and preformed into a self-supporting semi-rigid board.
 - 1. Flame Spread/Smoke Development: 5/0 per ASTM E 84.
 - 2. Non-combustibility: Listed as non-combustible by UL when tested in accordance with ASTM E-136.
 - 3. Moisture Absorption: Less than 0.1% by volume when tested in accordance with ASTM

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- C 1104.
4. Non-corrosive: Will not cause or contribute to corrosion; ASTM C 692, ASTM C 795 and ASTM C 871.
 5. Thermal Resistance: R 4.35/in. per ASTM C518.
 6. Manufacturers:
 - a. A/D Fire Protection Systems Inc. www.adfire.com.
 - b. CertainTeed Corp. www.certainteed.com.
 - c. Fibrex Insulations Inc. www.fibrex.on.ca.
 - d. Substitutions: See Section 016000 - Product Requirements.
- D. Firestop Devices - Wrap Type: Mechanical device with incombustible filler and sheet stainless steel jacket, intended to be installed after penetrating item has been installed; conforming to the following:
1. Durability and Longevity: Permanent.
 2. Manufacturers:
 - a. Grace Construction Products: www.na.graceconstruction.com.
 - b. 3M Fire Protection Products: www.3m.com/firestop.
 - c. Specified Technologies, Inc: www.stifirestop.com.
 - d. Substitutions: See Section 016000 - Product Requirements.
- E. Intumescent Putty: Compound which expands on exposure to surface heat gain; conforming to the following:
1. Potential Expansion: Minimum 500 percent.
 2. Density: 1.45 lb/cu ft.
 3. Solids: 100%.
 4. Durability and Longevity: Permanent.
 5. Color: Red.
 6. Manufacturers:
 - a. Grace Construction Products: www.na.graceconstruction.com.
 - b. 3M Fire Protection Products: www.3m.com/firestop.
 - c. Specified Technologies, Inc: www.stifirestop.com.
 - d. Substitutions: See Section 016000 - Product Requirements.
- F. Reusable Firestopping: Removable intumescent compressible shapes, pillows, or blocks specifically tested in removable configuration; conforming to the following:
1. Heat-Sealed Poly Bag: No sewn seams or fiberglass.
 2. Monolithic Encapsulated Core: No loose fill.
 3. Density: 4 lb/cu ft.
 4. Compression: As installed: 25% - 33%.
 5. Air Leakage: Less than 1 CFM/sq ft.
 6. Durability and Longevity: Permanent.
 7. Manufacturers:
 - a. Grace Construction Products: www.na.graceconstruction.com.
 - b. Nelson Firestop Products: www.nelsonfirestop.com.
 - c. Specified Technologies, Inc: www.stifirestop.com.
 - d. Substitutions: See Section 016000 - Product Requirements.
- G. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

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PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.
- B. Remove incompatible materials which may affect bond.
- C. Install backing materials to arrest liquid material leakage.

3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.
- C. Install labelling required by code.

3.4 CLEANING AND PROTECTION

- A. Clean adjacent surfaces of firestopping materials.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Sealants

1.2 SUBMITTALS

- A. Submit product data indicating sealant chemical characteristics, performance criteria, limitations, and color availability.

1.3 QUALIFICATIONS

- A. Applicator: company specializing in applying sealants with minimum three years experience.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers - sealants:
 - 1. Sonneborn
 - 2. General Electric
 - 3. Dow Corning
 - 4. Pecora
 - 5. United States Gypsum

2.2 MATERIALS

- A. Sealant AC: Acoustical Sealant (use at electrical outlets and top/bottom of partitions)
 - 1. ASTM C-919
- B. Sealant Type AL: acrylic latex sealant (typical interior use)
 - 1. ASTM C834 for latex sealing compounds.
 - 2. Joint movement capability: $\pm 7.5\%$
- C. Sealant SL: Urethane Sealant, Self-Leveling (use in horizontal joints in concrete slabs)
 - 1. ASTM C-920, Type M, Grade P, Class 25, uses T, M, O.
 - 2. Joint movement capability: $\pm 25\%$
- D. Sealant Type MR: Silicone Sealant (use around plumbing fixtures, sinks)
 - 1. ASTM C920, Type S, Grade NS, Class 25, uses NT, G, A, O.

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2. Joint movement capability: $\pm 25\%$
- E. Sealant U2: Urethane Sealant, single component (typical exterior use)
 1. ASTM C-920, Type M, Grade NS, Class 25, uses NT, M A, O.
 2. Joint movement capability: $\pm 25\%$
- F. Backer rod (typical use except Sealant type SL)
 1. Provide closed-cell polyethylene rod designed for use with cold applied joint sealants.
 2. Provide backer rod of size required for joint design.
- G. Joint Filler (use with Sealant SL)
 1. Provide closed-cell polyethylene joint filler designed for use with cold applied joint sealants.
 2. Provide joint filler of size required for joint design.
- H. Color of sealants will be selected by the Owner/Architect from the manufacturer's standard color range.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. 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 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 APPLICATION

- A. Back-up Material
 1. Verify the compatibility of back-up material with sealant before installation.
 2. Use back-up material 1/2 wider than width of joint to provide substantial resistance to displacement.
- B. Release Agent: apply release agent or bond-breaker strip in joint to be sealed on top of back-up material to prevent adhesion of sealant to the back-up material per manufacturer's recommendations.
- C. Sealant Application:
 1. Prepare sealants that require mixing following manufacturer's recommended procedures, mixing thoroughly.

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2. Apply materials in accordance with the manufacturer's recommendations taking care to produce beads of proper width and depth, to tool as recommended by the manufacturer and to immediately remove surplus sealant.
3. Apply materials only within manufacturer's specified application life period. Discard sealant after application life is expired or if the prescribed application period has elapsed.

3.3 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur

3.4 SCHEDULE

- A. Sealant AC applications:
 1. Around penetrations of acoustical partitions.
 2. Along bottom edge of acoustical gypsum board partitions.
 3. Seal sides and backs of electrical boxes.
- B. Sealant Type AL applications:
 1. At interior control joints.
 2. Between adjacent construction and equipment, woodwork,
 3. Perimeters of door and window frames, access panels, etc.
 4. Between interior partitions and adjoining concrete or steel columns, walls, or other construction.
 5. Other interior joints of small dimension which require painting.
 6. Gypsum board partitions:
 - a. Between gypsum panels and metal track at floors and dissimilar walls; install sealant just prior to installation of gypsum panel.
 - b. Between adjacent face layers of abutting intersection gypsum board partitions; install sealant before taping and finishing joint.
 - c. Between gypsum panels and penetrations: Seal around openings of ducts, pipes, etc.
 - d. Seal control joints prior to installing control joint trim.
 7. Other concealed locations within partitions to completely seal against passage of air.
- C. Sealant SL applications:
 1. In horizontal joints in floors (interior).
- D. Sealant Type MR applications:
 1. Between adjacent construction and sinks, counter tops, equipment, plumbing cut-outs, plumbing fixtures, etc.
 2. Joint between countertop backsplash/endsplash and wall.

END OF SECTION

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SECTION 081213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel frames.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, frame profiles, metal thicknesses, and wall opening conditions.
- C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steelcraft, Ceco, Curries, or equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated 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 according to NFPA 252 or UL 10C.

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1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 STANDARD STEEL FRAMES

- A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Interior Frames: SDI A250.8. Level 2.
 1. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 2. Construction: Face welded.
 3. Exposed finish: Factory primed for field finish.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 1. Type: Stud wall type: Designed to engage stud, welded to the back of frames, not less than 0.042 inch thick. Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

2.5 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. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

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- D. Power-Actuated Fasteners in Concrete: Fabricated from corrosion-resistant materials.

2.6 FABRICATION

- A. 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. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: SDI A250.10.
- B. Factory Finish: SDI A250.3.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with SDI A250.11.
- B. 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.

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1. 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.
 2. Install frames with removable stops located on secure side of opening.
- C. Fire-Rated Openings: Install frames according to NFPA 80.
- D. Floor Anchors: Secure with postinstalled expansion anchors.
1. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- E. Solidly pack mineral-fiber or fiberglass insulation inside frames.
- F. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

3.2 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

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083113 – ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

1. Section Includes: Access doors and frames for walls and ceilings.

1.2 RELATED SECTIONS

- A. Section 09200 – Gypsum Board
- B. Section 099100 – Painting.

1.3 SUBMITTALS

- A. Submit pursuant to Section 013300 – Submittal Procedures.
- B. Submit manufacturer's product data for each type of access door required.

1.4 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, electrical or other concealed work.
- B. Where access doors are required for access to electrical junction boxes or panels located above non-accessible ceilings, the subcontractor installing the boxes or panels shall be responsible for furnishing access doors or relocate boxes and panels to accessible locations.

1.5 SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.
- B. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.6 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

- A. Doors in insulated assemblies (if used) must be insulated and weatherstripped.

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B. Doors in wet locations shall be Stainless Steel, U.N.O.

2.2 NON-FIRE RATED ACCESS DOORS FOR WALLS AND CEILINGS

- . Frames: Minimum 16 gage steel.
 - 1. Flange: Integral exposed flange not less than 3/4 inch wide around the perimeter.
 - a. Gypsum board Applications: Expanded metal lath and exposed casing bead welded to perimeter of frame, in place of integral exposed flange.
- A. Door Panel: Flush type, minimum 14 gage steel.
 - 1. Hinges: Concealed type set to open a minimum of 135 degrees; continuous type, or sufficient framing to support the door size.
 - 2. Finish: Factory-applied rust inhibitive baked enamel or primer over phosphate treated steel.
- B. Cam Locks: Flush, screwdriver operated; sufficient number to hold door panel in flush, smooth plane when closed.
 - 1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
 - 2. Locations: Wall and ceiling.
 - 3. Door Size: 24"x 24", unless indicated otherwise on the drawings.
 - 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
 - 5. Frame Material: Same material, thickness, and finish as door.
 - 6. Latch and Lock: Cam latch, screwdriver operated.

1.2 A. FIRE-RATED ACCESS DOORS AND FRAMES

- A. Fire-Rated, Flush Access Door with Exposed Flanges:
 - 1. Karp Associates, Inc; KRP-150FR, or equal.
 - 2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
 - 3. Optional Features: Gasketing.
 - 4. Locations: Wall, as shown for each location, gypsum wall board finish.
 - 5. Door Size: 24"x 24", or other sizes as required for MEP access.
 - 6. Fire-Resistance Rating: Not less than 1 hour in rated wall locations. Provide access panels with ratings to
 - 7. Uncoated Steel Sheet for Door: Nominal 20 gage, factory primed, for field finishing.
 - 8. Frame Material: Same material, thickness, and finish as door.
 - 9. Latch and Lock Cam latch, screwdriver operated.

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1.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

1.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1.5 FINISHES

- 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.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 2 – EXECUTION

2.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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2.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

2.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

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SECTION 081400 - WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Section specifies Flush Wood Doors; and Stile and Rail Wood Doors of the following types:
 - 1. Interior fire-rated wood stile and rail flat panel doors.
 - 2. Interior fire-rated flush wood doors.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections.
 - 1. Section 08113 – Hollow Metal Frames
 - 2. Section 087100 - Door Hardware.
 - 3. Section 099100 – Painting: For wood doors and HM frames.
 - 4. Section 012100 - Allowances

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each type of stile-and-rail and flush wood door including elevations and details of construction.
- B. Shop Drawings: Submit shop drawings of wood doors including door type, door design number, door size, fire rating if applicable, hardware types and locations, hardware blocking requirements and location, panel layout, and sticking profile, and finishing.
- C. Verification Samples: Submit two corner samples, minimum 6 inches by 6 inches representing actual products and materials specified indicating visual characteristics and finish. Include range samples if variation of appearance is anticipated.
- D. Warranty: Submit manufacturer's Lifetime Warranty.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Company specializing in manufacturing doors with a minimum of five years documented experience.
- B. Single Source Requirements: To the greatest extent practical, each type wood door shall be supplied from a single manufacturer.
- D. Project Conditions: Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions, recommendations and industry standards.
- B. Store materials in manufacturer's original labeled packaging until ready for installation and in

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accordance with manufacturer's instructions. Protect from damage.

1.5 PERFORMANCE

- A. 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.

1.6 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard limited warranty that each panel door bearing the manufacturer's brand and identification mark complies with Industry Standard WDMA I.S.6A and all revisions in effect as of the date of manufacture, and that each such door, at the time of the shipment, is of good material and workmanship and free from defects that would render such door unserviceable or unfit for the ordinary, recommended use.

Warranty Period: Interior Doors – Lifetime limited warranty.

PART 2 PRODUCTS

2.1 PRODUCTS

- A. Interior Wood Stile and Rail Doors: Basis of Design: Forte Opening Solutions, Authentic Stile & Rail Doors, Flat Panel Stile and Rail, Category "A" or approved equal substitution.
 - 1. Construction: Square Profile
 - a. Stile-and-rail construction, sizes as shown on the Door Schedule.
 - 2. Shaker style doors with two (2) solid flat panels, Design A102: 20 minute fire rated for smoke.
 - 3. Wood species: Paint Grade Poplar for factory primed finish, flat panel with Shaker style, square sticking.
 - 4. Thickness: 1-3/4", sizes and configuration as shown on the drawings
 - 5. Panel Details: 5/8" Flat Panel with Fire Rated MDF core.
- B. Fire-Rated Flush Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
- C. Basis of Design: Eggers Industries, Graham Wood Doors; an Assa Abloy Group Company, Marshfield-Algoma/Masonite (Forte), VT Industries or approved substitution.
 - a. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - b. Structural Composite Lumber-Core Doors: Structural Composite Lumber: WDMA I.S.10. for doors with
 - Screw Withdrawal, Face: 700 lbf.
 - Screw Withdrawal Edge: 400 lbf.
 - c. Grade: Custom.
 - d. Faces: Paint Grade Poplar or Birch, factory primed finish.
 - e. Core: Fire rated Particleboard or MDF for 20 - minute fire rating for smoke.

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- f. Construction: Five plies. Stiles and rails bonded to core, then entire unit is abrasive planed before veneering.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Examine and prepare openings and substrates using the methods recommended by manufacturer.

1. FABRICATION

- a. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting.
 - a. Comply with NFPA 80 requirements for fire-rated doors.
- b. Factory machine doors for hardware that is not surface applied.

2. SHOP PRIMING

- a. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer. Field finish as specified in Section 099123 "Painting."

3. FACTORY FINISHING

- a. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - a. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- b. Factory prime finish all doors for field painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- c. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - a. Install fire-rated doors according to NFPA 80.
 - b. Install smoke- and draft-control doors according to NFPA 105.

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- d. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - a. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - 1. Comply with NFPA 80 for fire-rated doors.
- e. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- f. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction. Operate doors and adjust installation to provide proper operation of opening.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 081400

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
1. Swinging doors.
- B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
 2. Cylinders specified for doors in other sections.
- C. Related Sections:
1. Section 081213 Hollow Metal Frames.
 2. Section 081416 Flush Wood Doors.
 3. Section 081433 Stile and Rail Wood Doors
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 2. ICC/IBC - International Building Code.
 3. NFPA 70 - National Electrical Code.
 4. NFPA 80 - Fire Doors and Windows.
 5. NFPA 101 - Life Safety Code.
 6. NFPA 105 - Installation of Smoke Door Assemblies.
 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
1. ANSI/BHMA Certified Product Standards - A156 Series.
 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 3. ANSI/UL 294 - Access Control System Units.
 4. UL 305 - Panic Hardware.
 5. ANSI/UL 437- Key Locks.

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1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- D. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

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1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.

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- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

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1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 - 4. Hinge Options: Comply with the following:

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- a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

- a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.2 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy. Manufacturer shall be based in the United States of America.

1. Manufacturers:

- a. Medeco (MC).
- b. No Substitution.

- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

- 1. Threaded mortise cylinders with rings and cams to suit hardware application.
- 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
- 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
- 4. Tubular deadlocks and other auxiliary locks.
- 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
- 6. Keyway: Manufacturer's Standard.

- C. Small Format Interchangeable Cores: Provide small format interchangeable cores (SFIC) as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.

- D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents.

- 1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
- 2. Manufacturers:
 - a. Medeco (MC) - X4.
 - b. No Substitution.

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- E. Keying System: SFIC Final keying by Owner.

Registered key blanks letter of authorization will be provided for supplier to purchase and drop ship to:

PMD Lock Shop
Attn: Gary Tibbitts
15 Columbia Street
Augusta, ME 04330
207-287-4150
gary.tibbitts@maine.gov

- F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).

- G. Key Registration by Owner, existing system.

2.3 MORTISE LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 8200 Series.
 - b. No Substitution.

2.4 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Cycle Testing: Provide closers which have surpassed 15 million cycles.
4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

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6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.
1. Manufacturers:
 - a. LCN Closers (LC) - 4040XP Series.
 - b. Sargent Manufacturing (SA) - 281 Series.

2.5 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, .050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Rockwood (RO).

2.6 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

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- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Manufacturers:
 - a. Rockwood (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Manufacturers:
 - a. Norton Rixson (RF).
 - b. Sargent Manufacturing (SA).

2.7 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:

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1. Pemko (PE).

2.8 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.9 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

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- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and 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 specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 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.

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3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handing and sizing all products.
 - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
 - 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.
- C. Manufacturer's Abbreviations:
 - 1. MK - McKinney
 - 2. SA - SARGENT
 - 3. MC - Medeco
 - 4. BE - BEST Locks & Closers
 - 5. RF - Rixson
 - 6. RO - Rockwood
 - 7. PE - Pemko

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Hardware Sets

Set: 1.1

Doors: 314, 316, 318, 414, 416, 418

3 Hinge, Spring	1502	US10B	MK	087100
1 Institutional Privacy Lock	70 8257 LNL x LB thumb turn	US10B	SA	087100
1 Small Format Inter Core	33_00006_ P GGMK	13	MC	087100
1 Temporary Construction Core	- Provided by Owner		BE	087100
1 Surface Closer	281 O - pull side mount	EB	SA	087100
1 Smoke Seal	S88BL - head and jambs		PE	087100

Notes: Key locks and unlocks outside lever.

Key outside retracts latch bolt, overriding thumb turn when held in locked position.

Thumb turn inside locks and unlocks outside lever.

Lever outside unlocks when the door closes or operating lever inside.

Inside lever always retracts latch bolt.

Set: 1.2

Doors: 311, 312, 315, 317, 319, 320, 321, 411, 412, 415, 417, 419, 420, 421

3 Hinge, Spring	1502	US10B	MK	087100
1 Institutional Privacy Lock	70 8257 LNL x LB thumb turn	US10B	SA	087100
1 Small Format Inter Core	33_00006_ P GGMK	13	MC	087100
1 Temporary Construction Core	- Provided by Owner		BE	087100
1 Conc Overhead Stop	2-X36	613E	RF	087100
1 Smoke Seal	S88BL - head and jambs		PE	087100

Notes: Key locks and unlocks outside lever.

Key outside retracts latch bolt, overriding thumb turn when held in locked position.

Thumb turn inside locks and unlocks outside lever.

Lever outside unlocks when the door closes or operating lever inside.

Inside lever always retracts latch bolt.

Set: 2.1

Doors: 305, 405

3 Hinge, Full Mortise	TA2714 (NRP)	US10B	MK	087100
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1 Institutional Privacy Lock (w/ indicator)	V20 70 8257 LNL x LB thumb turn	US10B	SA	087100
1 Small Format Inter Core	33_00006_ P GG MK	13	MC	087100
1 Temporary Construction Core	- Provided by Owner		BE	087100
1 Surface Closer	281 O - pull side mount	EB	SA	087100
1 Kick Plate	K1050 10" high CSK BEV	US10B	RO	087100
1 Wall Stop	RM860	US10B	RO	087100

Notes: Key locks and unlocks outside lever.
Key outside retracts latch bolt, overriding thumb turn when held in locked position.
Thumb turn inside locks and unlocks outside lever.
Lever outside unlocks when the door closes or operating lever inside.
Inside lever always retracts latch bolt.

Set: 2.2

Doors: 304, 404

3 Hinge, Full Mortise	TA2714 (NRP)	US10B	MK	087100
1 Institutional Privacy Lock (w/ indicator)	V20 70 8257 LNL x LB thumb turn	US10B	SA	087100
1 Small Format Inter Core	33_00006_ P GG MK	13	MC	087100
1 Temporary Construction Core	- Provided by Owner		BE	087100
1 Surface Closer	281 CPS	EB	SA	087100
1 Kick Plate	K1050 10" high CSK BEV	US10B	RO	087100

Notes: Key locks and unlocks outside lever.
Key outside retracts latch bolt, overriding thumb turn when held in locked position.
Thumb turn inside locks and unlocks outside lever.
Lever outside unlocks when the door closes or operating lever inside.
Inside lever always retracts latch bolt.

Set: 3

Doors: 302, 402

3 Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP)	US10B	MK	087100
1 Passage Latch	8215 LNL	US10B	SA	087100
1 Surface Closer	281 O - pull side mount	EB	SA	087100
1 Kick Plate	K1050 10" high CSK BEV	US10B	RO	087100
1 Wall Stop	RM860	US10B	RO	087100
1 Smoke Seal	S88BL - head and jams		PE	087100

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Set: 4

Doors: 300A, 300B, 400A, 400B

3 Hinge, Full Mortise	TA2714 (NRP)	US10B	MK	087100
1 Storeroom Lock	70 8204 LNL	US10B	SA	087100
1 Small Format Inter Core	33_00006_ P GGMK	13	MC	087100
1 Temporary Construction Core	- Provided by Owner		BE	087100
1 Surface Closer	281 CPS	EB	SA	087100
1 Kick Plate	K1050 10" high CSK BEV	US10B	RO	087100
1 Smoke Seal	S88BL - head and jambs		PE	087100

Notes: Function: Latch bolt operated by key outside or lever inside. Outside lever always rigid. Inside lever always free for egress.

Set: 5

Doors: 200A

3 Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP)	US10B	MK	087100
1 Institutional Privacy Lock	70 8257 LNL x LB thumb turn	US10B	SA	087100
1 Small Format Inter Core	33_00006_ P GGMK	13	MC	087100
1 Temporary Construction Core	- Provided by Owner		BE	087100
1 Surface Closer	281 P10	EB	SA	087100
1 Kick Plate	K1050 10" high CSK BEV	US10B	RO	087100
1 Wall Stop	RM860	US10B	RO	087100
1 Smoke Seal	S88BL - head and jambs		PE	087100

Notes: Key locks and unlocks outside lever.
Key outside retracts latch bolt, overriding thumb turn when held in locked position.
Thumb turn inside locks and unlocks outside lever.
Lever outside unlocks when the door closes or operating lever inside.
Inside lever always retracts latch bolt.

END OF SECTION

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SECTION 091116 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal stud framing
- B. Suspension system for gypsum wallboard ceilings and soffits.
- C. Shaft wall framing, as shown for Wall Type - W4.

1.2 SUBMITTALS

- A. Submit manufacturer's product data and standard component framing details, stud layout, framed openings, anchorage to structure, type and location of fasteners, and accessories as recommended by manufacturer.
- B. Submit method for securing studs to tracks, splicing, for blocking and reinforcement for framing connections.

PART 2-PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers:
 - 1. G-P Gypsum Products
 - 2. Gold Bond
 - 3. Unimast (USG)

2.2 STUD FRAMING MATERIALS

- A. System components: ASTM C645.
 - 1. Non-load bearing studs: ASTM A924 rolled steel, channel shaped, punched for utility access, 20 gauge, electrogalvanized ; .
 - 2. Finish: galvanize to G40 coating class per ASTM A525.
 - 3. Runners: same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud,
 - 4. Ceiling runners: with extended leg retainer.
 - 5. Furring and bracing members: same material as studs; thickness to suit purpose.
- B. Fasteners: ASTM C1002, self-drilling, self-tapping screws, type S or S-12.
- C. Sheet metal backing: 16 gage thick galvanized steel for reinforcement.
- D. Anchorage devices: power actuated.
- E. Steel Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission, fabricated from steel sheet complying with ASTM A525 or ASTM A568 to form 1/2" deep channel; hat-shaped channel, with 1-1/2" wide face connected to flanges by double slotted or expanded metal legs (webs).
- F. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: AISI S220 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide

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- lateral bracing.
- 2. Double-Runner System: AISI S220 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
- 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products:
 - 1) ClarkDietrich Building Systems; BlazeFrame DSL SLP-TRK Slotted Deflection Track.
 - 2) MBA Building Supplies; FlatSteel Deflection Track or Slotted Deflecto Track.
 - 3) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
 - 4) Telling Industries; Vertical Slip Track or Vertical Slip Track II.
- G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Manufacturers: Fire Trak Corp., Metal-Lite. Steel Network, Inc. (The), or equal.
- H. Acoustic sealant (sealant type AC): refer to SECTION 079200.
- Ceiling Suspension for Gypsum Wallboard Ceilings:
 - 1. Provide standard zinc-coated or painted steel system of furring runners, furring tees and accessories designed for concealed support of gypsum wallboard ceilings.
 - 2. Provide screws, clips, bolts, cast-in-place concrete inserts or other devices applicable to the structural system for ceiling hangers and whose suitability for use intended has been proven by certified test data. Size devices for three times calculated load supported except size direct pull-out concrete inserts for five times calculated loads.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
 - 1. Depth: 1-1/2 inches.
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inchwide flanges, 3/4 inch deep.
 - 2. Steel Studs and Runners: ASTM C 645.

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- a. Minimum Base-Metal Thickness: 0.0179 inch (18 mils).
 - b. Depth: As indicated on Drawings.
 - 3. Equivalent Gauge Steel Studs and Runners: AISI S220 and ASTM C 645, Section 10.
 - a. Minimum Base-Metal Thickness: 0.015 inch.
 - b. Depth: As indicated on Drawings.
 - 4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Steel Thickness: 0.0179 inch.
 - 5. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission. Configuration: Asymmetrical.
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

PART 3-EXECUTION

3.01 ERECTION

- A. Install steel framing members following the requirements of ASTM C754.
- B. Align and secure top and bottom runners at 24" on center (maximum).
- C. Place acoustical sealant (sealant type AC) between runners and substrate, studs and adjacent construction to achieve a seal.
- D. Space studs 16" on center, rotated and anchored into place in floor and ceiling channels. Permanently lock studs adjacent to doors, windows, partition intersections and corners into channels with 3/8" self-tapping screws through channels into studs.
- E. Locate studs rough openings for doors and windows with double studs. Anchor jamb studs with self tapping screws or bolts or by welding to door frame anchors and window jamb clips. Verify that frame anchors provided by Section 08110 are correct for stud system used.
- F. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- G. Align stud web openings horizontally.
- H. Secure studs to bottom tracks using crimping or fastener method. Do not weld. Do not fasten studs to top track.
- I. Stud splicing is not permissible.
- J. Blocking for support of wall mounted plumbing fixtures, toilet partitions, counters, wall mounted equipment, wall mounted toilet accessories, wall mounted door stops and hardware.
 - 1. Install 16 gage steel sheet x 4" wide (minimum) blocking to studs. Coordinate with equipment and hardware installers for specific locations required for reinforcement.
 - 2. Install fire-retardant treated lumber, 4" wide by length required, anchored to a minimum of two metal studs, in areas required by code.. Coordinate with equipment and hardware installers for specific locations required for reinforcement.
- K. Coordinate placement of insulation in stud spaces made inaccessible after stud framing erection.

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SECTION 092300 - GYPSUM PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum plastering on expanded-metal lath.
2. Finish-coat gypsum plaster materials.

- B. Repair of existing plaster shall conform to Preservation Brief No. 21 "Repairing Historic Flat Plaster Walls and Ceilings" as published by the National Park Service.**

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product.

- B. Shop Drawings:** Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, contamination, corrosion, construction traffic, and other causes.**

1.4 FIELD CONDITIONS

- A. Comply with ASTM C842 requirements or gypsum plaster manufacturer's written recommendations, whichever are more stringent.**

- B. Room Temperatures:** Maintain temperatures at not less than 55 deg F or greater than 80 deg F for at least seven days before application of gypsum plaster, continuously during application, and for seven days after plaster has set or until plaster has dried.

- C. Avoid conditions that result in gypsum plaster drying out too quickly.**

1. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Maintain relative humidity levels for prevailing ambient temperature that produce normal drying conditions.
3. Ventilate building spaces in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide gypsum plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.
- B. Sound-Transmission Characteristics: Where indicated, provide gypsum plaster assemblies identical to those of assemblies tested for STC ratings according to ASTM E90 and classified according to ASTM E413 by a qualified testing agency.

2.2 EXPANDED-METAL LATH

- A. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.

- 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. Alabama Metal Industries Company; a Gibraltar Industries company.
 - b. ClarkDietrich Building Systems.
 - c. Marino\WARE.

Paper Backing: Kraft paper factory bonded to back of lath.

- 1. Diamond-Mesh Lath:
 - a. Type: Self-furring.
 - b. Weight: 2.5 lb/sq. yd.

2.3 PANEL PRODUCTS

- A. Gypsum Base for Veneer Plaster, Type X: ASTM C1396/C1396M.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corp.; ProRoc Veneer Plaster Base, Type X.
 - b. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; Tough Rock Fireguard Veneer Plaster Base.
 - c. National Gypsum Company; Kal-Core Fire-Shield, Type X.
 - d. USG Corporation; Imperial Firecode Gypsum Base.

- 2. Thickness: 5/8 inch.H

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2.3 ACCESSORIES

- A. General: Comply with ASTM C841, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Metal Accessories:
 - 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. Alabama Metal Industries Company; a Gibraltar Industries company.
 - b. ClarkDietrich Building Systems.
 - c. Marino\WARE.
 - 2. Cornerite: Fabricated from expanded-metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
 - 3. Striplath: Fabricated from expanded-metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
 - 4. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.
 - a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
 - b. Smallnose cornerbead with perforated flanges; use on curved corners.
 - c. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
 - d. Bullnose cornerbead, radius 3/4-inch minimum, with expanded flanges; use at locations indicated on Drawings.
 - 5. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
 - 6. Control Joints: Fabricated from zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 - 7. Expansion Joints: Fabricated from zinc-coated (galvanized) steel] folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
 - 8. Two-Piece Expansion Joints: Fabricated from zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch wide; with perforated flanges.

2.4 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. Bonding Compound: ASTM C631.
- C. Fasteners for Attaching Metal Lath to Substrates: ASTM C841.
- D. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.

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- E. Joint Tape: Gypsum Base for Veneer Plaster: As recommended by gypsum veneer plaster manufacturer for applications indicated.
- F. Embedding Material for Joint Tape:
 - 1. Gypsum Base for Veneer Plaster: As recommended by gypsum veneer plaster manufacturer for use with joint-tape material and gypsum veneer plaster applications indicated.
- G. 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 rated assembly.
- H. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
- I. Mix Additives: Use gypsum plaster accelerators and retarders from plaster manufacturer if required by Project conditions. Use only additives that manufacturer recommends in writing for use with plaster to which it is added.

2.5 BASE-COAT GYPSUM PLASTER MATERIALS

- A. Lightweight-Gypsum Ready-Mixed Plaster: ASTM C28/C28M, with mill-mixed perlite aggregate.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. National Gypsum Company; Gold Bond Gypsolite.
 - b. USG Corporation; Structo-Lite.

2.6 FINISH-COAT GYPSUM PLASTER MATERIALS

- A. Gypsum Ready-Mixed Finish Plaster: Manufacturer's standard, mill-mixed, gaged, interior finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. National Gypsum Company; Gold Bond Kal-Kote Smooth.
 - b. USG Corporation; Diamond Brand Interior Finish Plaster.

2.7 PLASTER MIXES

- A. Mixing: Comply with ASTM C842 and manufacturer's written instructions for applications indicated.
- B. Mix Additives: Use accelerators and retarders, if required by Project conditions, according to manufacturer's written instructions.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Reject plaster materials that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

3.3 INSTALLATION, GENERAL

- A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
- B. STC-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
- C. Sound-Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.
- D. Acoustical Sealant: Where required, seal joints between edges of plasterwork and abutting construction with acoustical sealant.

3.4 INSTALLATION OF EXPANDED-METAL LATH

- A. Expanded-Metal Lath: Install according to ASTM C841.
 - 1. Partition Framing and Vertical Furring: Install flat-diamond-mesh lath.
 - 2. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh lath.

3.5 INSTALLING PANELS

- A. Install panels for veneer plaster in locations indicated on Drawings.
- B. Single layer application:
 - 1. On ceilings, apply gypsum base panels before wall panels, to the greatest extent

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- possible and at right angles to framing unless otherwise indicated.
2. On walls, apply gypsum base panels vertically and parallel to framing unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other walls higher than 30 feet, install gypsum base panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. On Z-furring, apply gypsum base panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- C. Fasteners: Drive fasteners flush with gypsum base surface. Do not overdrive fasteners or cause surface depressions.
- D. Single-Layer Fastening Methods: Apply gypsum base panels to supports with steel drill screws.

3.6 INSTALLATION OF ACCESSORIES

- A. General: Install according to ASTM C841.
- B. Cornerbeads: Install at external corners.
- C. Casing Beads: Install at terminations of plasterwork, except where plaster passes behind and is concealed by other work and where metal screeds, bases, or frames act as casing beads.
- D. Control Joints: Locate as approved by Architect for visual effect, with spacing between joints in either direction not exceeding the following:
 1. Partitions: 30 feet.
 2. Ceilings: 30 feet.
- E. Aluminum Trim: Install according to manufacturer's written instructions.

3.7 INSTALLING JOINT REINFORCEMENT

- A. Gypsum Base: Reinforce interior angles and flat joints with joint tape and embedding material To comply with ASTM C843 and with gypsum veneer plaster manufacturer's written recommendations.

3.8 REPAIR OF SMALL CRACKS AND MINOR DAMAGE

- A. Remove existing damaged plaster back to a point which sound material is reached.
- B. Remove loose and foreign matter that could impair adhesion.
- C. Fill voids with plaster patching compound; apply with sufficient pressure to eliminate voids and ensure adhesion.
- D. Finish to match adjacent surfaces.

3.2 REPAIR OF LARGE CRACKS

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- A. Remove existing damaged plaster back to a point which sound material is reached.
- B. Remove loose and foreign matter that could impair adhesion.
- C. Fill voids with plaster patching compound; apply with sufficient pressure to eliminate voids and ensure adhesion.
- D. Embed tape in wet compound. Apply additional compound to cover tape.
- E. Finish to match adjacent surfaces.

3.3 REPAIR OF DELAMINATED PLASTER LAYERS

- A. Remove existing damaged plaster back to a point which sound material is reached.
- B. Remove loose and foreign matter that could impair adhesion.
- C. Apply bonding agent in accordance with manufacturer's instruction.
- D. Fill voids with plaster patching compound; apply with sufficient pressure to eliminate voids and ensure adhesion.
- F. Finish to match adjacent surfaces.

3.4 REPAIR DAMAGED PLASTER OVER METAL LATH

- A. Remove existing damaged plaster down to lath.
- B. Reattach loose lath with wire ties.
- C. Install expanded-metal lath. Provide appropriate type, configuration, and weight of metal lath selected from materials indicated that comply with referenced lathing installation standards.
- D. Apply scratch, brown, and finish coats to thickness to match existing plaster.
- E. Finish to match adjacent surfaces.
- F. Where demolition note is called for (removal of entire lath and plaster), gypsum base with Taped joints and veneer plaster may be used in lieu of metal lath and plaster.
- G. Other repairs to plaster at metal lath may consist of metal lath or gypsum base at contractor's option. Finish shall match adjacent areas.

3.5 REPAIR DAMAGED PLASTER OVER MASONRY

- A. Remove existing damaged plaster down to masonry.
- B. Route out mortar joints to 5/8 inch depth.
- C. Apply bonding agent in accordance with manufacturer's instructions.
- D. Apply scratch, brown, and finish coats to thickness to match existing plaster.
- E. Finish to match adjacent surfaces.

3.7 APPLICATION OF PLASTER FOR NEW WORK

- A. General: Comply with ASTM C842.
 - 1. Do not deviate more than plus or minus 1/8 inch in 10 feet from a true plane in finished plaster surfaces when measured by a 10-foot straightedge placed on surface.
 - 2. 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.
 - 3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

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- B. Bonding Compound: Apply on unit masonry substrates for direct application of plaster.
- C. Base-Coat Plaster:
 - 1. Over Expanded-Metal Lath:
 - a. Scratch Coat: Gypsum Neat plaster with job mixed sand.
 - b. Brown Coat: Lightweight-gypsum ready-mixed plaster.
 - 2. Over Unit Masonry: Lightweight-gypsum ready-mixed plaster.
 - 3. Over Monolithic Concrete: Gypsum neat plaster with job-mixed sand.
- D. Finish Coats: Smooth-Troweled Finishes:
 - 1. Materials: Gypsum ready-mixed finish plaster.
 - 2. Locations: Provide finish to match existing.
- E. Concealed Plaster:
 - 1. Where plaster application is concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
 - 2. Where plaster application is concealed above suspended ceilings and in similar locations, omit finish coat.
 - 3. Where plaster application is used as a base for adhesive application of tile and similar finishes, omit finish coat.

3.8 PLASTER REPAIRS

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.9 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 092300

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Gypsum board for walls and ceilings.
- B. Sound attenuation insulation for partitions.
- C. Stencil partition ratings above finish ceiling for Owner's identification.
- D. Shaft wall assembly

1.2 SUBMITTALS

- A. Submit a complete list of all materials proposed to be furnished and installed under this portion of work, stating manufacturer's name and catalog number for each item.
- B. Submit manufacturer's recommended method of installation for each item. These recommendations shall be basis for acceptance or rejection of actual installation methods used in this work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers - gypsum board:
 - 1. National Gypsum Company
 - 2. United States Gypsum

2.2 MATERIALS

- A. Fire rated gypsum board: 5/8 inch Type "X", ASTM C36; fire resistive type, UL rated; ends square cut with tapered and beveled edges.
- B. Moisture and Mold-Resistant Type, GPDW-MR: ASTM C 630 with moisture- and mold-resistant core and surfaces. 5/8 inch, Type X core, mold-Resistance: ASTM D3273, rating of 10. Face Sheets: 100 percent post-consumer recycled content.
(Location: Walls and ceilings of toilet rooms, and as specified on the drawings)
Products: G-P Gypsum Corp.; Toughrock Mold-Guard Gypsum Board, National Gypsum Co.; Gold Bond Brand XP Gypsum Board, United States Gypsum Co.; Fiberock Aqua-Tough Interior Panels.
- C. Tile Backing Panels: Glass-Mat, Water-Resistant Backing Board: 5/8 inch Type "X" ASTM C1178/C1178M, with manufacturer's standard edges. Mold resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- D. Gypsum Shaftwall or Coreboard: ASTM C1396, 1396M Type X Core; sizes to minimize joints in place; 1 inch thick, square, tongue and groove. Or double beveled edges, ends cut square.
- D. Fasteners: steel drill screws (ASTM C1002) or fasteners recommended by gypsum board manufacturer.
- E. Sound attenuation blankets shall be paperless, semi-rigid spun mineral fiber batts, 2.5 pounds per

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cubic foot density, 2" thick, UL rated Class A (flame spread of 25 or less) noncombustible per ASTM E84.

- E. Trim accessories for interior installation: Corner beads, edge trim, and control joints complying with ASTM C1047; sheet steel, zinc-coated by hot-dip process:
 - 1. Corner beads: equivalent to USG "Dur-A-Bead"; for use at outside corners.
 - 2. Inside corner: equivalent to USG "B2"; paper faced, metal backed inside corner.
 - 3. L-trim: equivalent to USG "L-Trim"; for use at door frames and where panels abut other materials.
 - 4. Control joints: one-piece control joint formed with V-shaped slot, with removable strip covering slot opening.
- F. Joint materials: ASTM C475; reinforcing tape, joint compound, adhesive, and water.
- G. Shaft Wall Assembly (To come).

2.3 PARTITION RATING IDENTIFICATION

- A. Stencil partition ratings above finish ceilings, at a height approved by the Owner, for the entire facility. Stenciled characters shall be 6 inches high, with red paint, every 20 feet maximum. In smaller areas, where the ratings change, identify ratings of the individual walls surrounding the spaces so that all partitions are identified.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Place sound attenuation blankets in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
- B. Install acoustical sealant within partitions in accordance with the manufacturer's instructions.
- C. Install gypsum board in accordance with ASTM C840.
- D. Use screws when fastening gypsum board to metal furring or framing.
- E. Treat cut edges and holes in moisture resistant gypsum board with sealant.
- F. Place control joints consistent with lines of building spaces as indicated.
- G. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

3.2 FINISHING

- A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes, in accordance with manufacturer's instructions.
- B. Feather coats onto adjoining surfaces so that camber is maximum 1/16".

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- C. Finish gypsum board to a uniformly smooth surface completely free from irregularities visible to the unaided eye at a distance of 5'-0" under final room lighting conditions

END OF SECTION

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SECTION 093013 – CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Porcelain wall and floor tile.
 - 2. Ceramic wall tile.
 - 3. Metal edge strips.
 - 4. Uncoupling Membrane.
 - 5. Waterproof Membranes
- B. Related Sections:
 - 1. Section 035413 – Gypsum Cement Underlayment: Coordinate substrate tolerances, leveling and patching, finishes and curing methods.
 - 2. Section 092900 - Gypsum Board: For tile backer boards.
- C. Coordinate with interior design details and specifications indicated on drawings. Refer to Drawing A125 for Restroom Tile Layout Details.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Manufacturer's product data for each type and composition of tile and for each color and finish required.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

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PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards reference
- C. TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

- A. Porcelain Floor Tile Type 1: DalTile Keystones 2-inch, Suede Gray D182 Matte, Unglazed.
 - 1. Face Size: 2 by 2 inches
 - 2. Thickness: (Verify).
 - 3. Grout Color: To be selected by Architect during submittal review.
- B. Ceramic Wall Tile Type 1: Daltile 4 by 16 inches, Color Wheel Linear – Matte Arctic White.
 - 1. Face Size: 4 by 16 inches
 - 2. Thickness: (Verify).
 - 3. Grout Color: To be selected by Architect by Architect during submittal review.
- C. Ceramic Wall Tile Type 2: Daltile 4 by 16 inches, Color Wheel Linear – Navy Glossy.
- D. Base and Trim Units:
 - 1. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Floor Base Tile 1: Daltile 4 by 16 inches, Color Wheel Linear – Matte Arctic White, module size same as adjoining flat tile (size).
 - b. Floor Base Tile 2: Daltile 4 by 16 inches, Color Wheel Linear – Navy Glossy, module size same as adjoining flat tile (size).

2.3 2.4 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

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- B. Waterproof Membrane, Fluid-Applied: Elastomeric Waterproofing Membrane, TCNA-14 (Above Ground Concrete) one component, liquid applied material having the following additional physical properties:
Hardness: Shore "A" between 40 – 60.
Elongation: Between 300 and 400 percent.
Tensile Strength: Between .27 - .41 Newton per millimeter (40-60 pounds per square inch gauge).
No Volatile Compounds (VOC).
Basis of Design: To be Determined.
- C. Waterproofing and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both waterproofing and tile-setting adhesive in a two-step process.
 - 1. Basis of Design: To be Determined.

2.5 UNCOUPLING MEMBRANE

- A. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 1/8-inch nominal thickness with a grid structure of 1/2-inch by 1/2-inch square cavities.
 - 1. Basis of Design Products: Provide products by the following or approved substitute:
 - a. Schluter Systems L.P.; DITRA.
 - b. Laticrete Strata Mat

2.4 SETTING MATERIALS

- A. Modified Dry-Set Portland Cement Mortar (Thinset): meeting both ANSI A118.4 and A118.15.
 - 1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
 - 2. For wall applications, provide nonsagging mortar.
 - 3. Products: Mapei Keraflex Super or Ultraflex LFT, Laticrete 255 Multimax or approved equal product by one of the following manufacturers:
 - a. Bonsal American, an Oldcastle company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. Laticrete International, Inc.
 - f. MAPEI Corporation.

2.5 GROUT MATERIALS

- A. Two-Component, Water-Cleanable Epoxy Grout: Mapei Kerapoxy QC, or equal product in compliance with ANSI A118.3, with a VOC content of 65 g/L or less. Color as specified by Architect.

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1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.6 MISCELLANEOUS MATERIALS

- A. Patching and Leveling Compound: Portland cement based, polymer-modified, self-leveling compound manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable. Patching and leveling compound with the following minimum properties:
 1. Compressive strength – 25 MPa (3500 psig) per ASTM C109/C109M.
 2. Flexural strength – 7 MPa (1000 psig) per ASTM C348 (28 day value)
 3. Tensile strength – 4.1 MPa (600 psi) per ANSI 118.7
 4. Density – 1.9.
 5. Capable of being applied in layers up to 38 mm (1-1/2 inches) thick without fillers, and up to 101 mm (4 inches) thick with fillers, being brought to a feather edge, and being troweled to a smooth finish.
 6. Primers, fillers, and reinforcement as required by manufacturer for application and substrate condition.
 7. Ready for use 48 hours after application.
- B. Metal Edge Strips: Schluter Schiene Angle or L-shape, height to match tile and setting-bed thickness,. Embedded leg keying into mortar, designed specifically for flooring applications; Brushed Stainless Steel, Type 304.
 1. Metal Transitions between Bathrooms and Corridor: Schluter Reno-U or Schluter Reno-Ramp
 2. Metal Edge at Wall, Tile Outside Corners (locations as shown on the Drawings): Jolly Trim Schluter-FINEC, finish to be selected by Architect.
 3. Transitions between Bathroom tiled floors and Corridor LVT: Schluter Reno-U or Schluter Reno-Ramp
 2. Metal Edge at Typical Outside Corners: Schluter FINEC, QUADec - K at outside corners where noted on the Plan, satin stainless steel. Add metal edge at top of tile for top of tile at half wall height.
 3. Metal Cove-shaped profile for wall to floor transitions and inside corners (DILEX-ANK).
 4. Floor Control Joint: Schluter DILEX – BWS.

2.7 ELASTOMERIC SEALANTS

- A. General: Provided manufacturer's sanded acrylic caulking containing mildewcide or antimicrobial protection.

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- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.
- C. Available Products: Provide products by the following or approved substitute:
 - 1. Keracaulk™ S by Mapei
 - 2. CeramaSeal by Bostik Findley

2.8 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' current written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

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3.3 INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches or larger.
 - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths as recommended by the tile manufacturer, and approved by the Architect.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, membranes, mortar beds, and tile. Do not saw-cut joints after installing tiles.
- 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- I. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- J. Back Buttering: For installations indicated below, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI

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A108/A118/A136 series of tile installation standards: (Tile installations composed of tiles 8 by 8 inches, or larger).

- K. Install Coupling membrane to comply with manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. CF128-09 and ANSI 118.1 Floors, Interior Crack Isolation Young Concrete, Uncoupling Membrane
 - a. Bond Coat and Thin-set for existing subfloor. Concrete floors: Modified dry-set/Improved modified dry-set mortar (verify with membrane manufacturer for proper adhesion).
 - b. Grout: Water-cleanable epoxy grout.
 - 2. TCNA F125-Full and ANSI 118.1: Thinset mortar on uncoupling membrane.
 - a. Ceramic Tile Type: **Floor Tile 1 & 2**, Porcelain.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
 - 3. Coordinate Floor Patterns with manufactured Tile Mesh Sheets and field tile. Refer to
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. TCNA W245 -14: Thinset mortar on glass-mat, water-resistant gypsum backer board. Treat joints with tape and polymer -modified Portland cement mortar.
 - a. Ceramic Tile Type: **Wall Tiles 1 & 2**.
 - b. Thinset Mortar: Modified dry-set/Improved modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
- C. Ceramic Wall Tile with Prefabricated Receptor, Cement Backer Board or Fiber Cement Backer Board, Metal Studs. Thinset mortar over waterproof membrane on glass-mat water resistant Cement Backer Board. Backer board joints and seams shall be prepared in strict accordance with this Standard before tile work can proceed.
 - 1. TCNA B412-22 Thinset mortar over waterproof membrane on glass-mat water resistant gypsum backer board.
 - 2. Ceramic Tile Types: **Wall Tiles 1 & 2**.

END OF SECTION

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SECTION 095123 - ACOUSTICAL TILE CEILING

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Install Acoustical Ceiling System
- B. Remove existing ceiling systems in areas to be reconfigured. Reinstall new systems.
- C. Hold-Down clip system
- D. Indirect Light Cove System, Refer to Electrical for Fixture S3 – Cove Light.

1.2 SUBMITTALS

- A. Submit product data of acoustical tiles specified and indirect cove system for verification.
- B. Shop drawings for installation of Indirect cove system interfacing with all other ceiling components.

PART 2-PRODUCTS

2.1 MATERIALS

- A. Exposed grid suspension system: Armstrong, Superfine XL exposed tee system, white.
 - 1. Suspension wire: 12 gage, galvanized annealed steel conforming to FS QQ-W-461, Class 1
 - 2. Exposed grid suspension system: steel factory finished in flat baked enamel, White. Main runner couplings and cross tee intersections shall be mechanically locked together to form permanent joint with bottom face of meeting members on a common plane. Provide factory-manufactured outside corners.
 - 3. System shall be sized and supported to limit installed deflection of ceiling system to 1/360 of span, including loads imposed by system and by mechanical and electrical devices supported by the system.
 - 4. System shall be designed to allow ceiling panels to be removed and replaced without damage; that main runners and cross runners may be removed and replaced without deforming runners or disturbing remainder of system.
 - 5. Install Armstrong Interlude XL grid system and accessories in strict accordance with manufacturer's instructions.
- B. Acoustical lay-in panel: **ACT-1** – Basis of Design: Armstrong World Industries Inc., Ultima High NRC, **No. 1941** 24"x 24" x 7/8" beveled tegular edge, white. (15/16" Interlude XL suspension grid)
- C. Acoustical lay-in panel: **ACT-2** – Basis of Design: Armstrong World Industries Inc. Ultima, High NRC **No. 1944** 24"x 48" x 7/8" beveled tegular edge, white. (with 15/16" Interlude XL suspension grid).
- D. Acoustical lay-in panel: **ACT-3** Basis of Design: Armstrong World Industries Inc. Ultima High NRC **No. 1436** 24"x 72" x 7/8" beveled tegular edge, white. (with 15/16" Interlude XL suspension grid).

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- E. Indirect Cove System: Basis of Design: Armstrong Axiom 8" Indirect Cove Light No. AXIDLCW448, or approved equal. Extruded aluminum light cove system, fully concealed fasteners, integrated design with acoustical and Gypsum drywall suspension systems. Heavy duty extruded aluminum alloy 6063 trim channel, finished with baked on polyester paint, white, color to match intersecting grid system. Heavy duty aluminum unfinished T-Bar connection clips; galvanized steel splice plates
1. Provide miscellaneous related items including cable tray, wall trim, hold down clips spring spacers, and other accessory items necessary for completion of ceiling system, as detailed on Drawing A411.

PART 3-EXECUTION

3.1 EXAMINATION

- A. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - LAY-IN GRID SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636 and as supplemented in this section.
- B. Install system capable of supporting imposed loads to a deflection of 1/360 maximum.
- C. Suspend ceiling hangers from building structural members and as follows:
1. Install suspension system after major above ceiling work is complete. Coordinate the location of hangers with other work.
 2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 4. Secure fiat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for structure to which hangers are attached as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 5. Do not support ceilings directly from permanent metal forms; furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to steel deck tabs.
 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 8. Space hangers not more than 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.
 9. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members

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10. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers to span the extra distance.
- D. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-width units at borders, and comply with reflected ceiling plans.
- E. Locate system on room axis according to reflected plan.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6' of each corner; or support components independently.
- G. Install edge moldings of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical units. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths. Provide edge moldings at junctions with other interruptions.
 1. Screw-attach moldings to substrate at intervals not over 16" on center and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12'-0".
 2. Miter corners accurately and connect securely.

3.3 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Install units after above ceiling work is complete.
- D. Install acoustical units level, in uniform plane, and free from twist, warp and dents.
- E. Cut units to fit irregular grid and perimeter edge trim. Field rabbet unit edge. Double cut and field paint exposed edges of exposed units.

3.4 ERECTION TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8" in 10'.

3.5 EXTRA STOCK

- A. Provide additional replacement stock of 2 percent full box,(minimum 12 tiles) for each of the tile types to Owner at completion of project.

END OF SECTION

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SECTION 096513 - RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

- A. Section Includes:
 - 1. Rubber Wall Base
 - 2. LVT Flooring
 - 3. LVT Acoustical Underlayment
 - 4. Resilient molding accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product.

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

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PART 2 - PRODUCTS

2.1 RESILIENT FLOORING

- A. LVT: (LVT-1): J&J Framework V5001, 9"x 48" Plank 5.0 mm thickness, with 20 mil wearlayer. Enhanced UV urethane with ceramic bead finish coating. Heavy commercial backing class. 15 year warranty.
- B. Integral Acoustical Mat: LVT Soundcheck Acoustical Underlayment, .055 inch thick frothered polyurethane foam, 25 lb/ft³ density. Greenguard Gold certified for low chemical emissions in accordance with 2818. ZPT antimicrobial protection (verify). Direct glue down, as recommended by the manufacturer under LVT.

2.3 RUBBER WALL BASE.

- C. Rubber Millwork Style base: Johnsonite Monument (MW-XX-S4, 4 inches high by 8', 1/4 inch thick thermoplastic rubber base in accordance with ASTM F-1861, Type TP, Group 1.

2.2 RESILIENT TRANSITIONS

- A. TBD Johnsonite, Roppe Corporation, USA, PVC free, phthalate free and Red List chemical free. Transitions as shown on drawings.
 - 1. Transition Strip between:___ __ _

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. Metal Edge Strips: (TBD) Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On existing masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

3.4 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.

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3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096500

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SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular, carpet tile.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Flooring" for resilient wall base and accessories installed with carpet tile.
 - 2. Section 035413 – Gypsum Cement Underlayment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Carpet tile type, color, and dye lot.
 - 2. Pattern of installation.
 - 3. Pattern type, location, and direction.
 - 4. Type, color, and location of insets and borders.
 - 5. Type, color, and location of edge, transition, and other accessory strips.
 - 6. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile and backing: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch long Samples.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

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1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.8 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.9 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: Lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

- A. For an explanation of options and Contractor's product selection procedures, see Section 016000 "Product Requirements."

Carpet Tile: Basis of Design: Milliken Stereovision, Light Wave Eco Low Embodied Carbon.

- 1. Size: 9.84" x 39.4" Planks
- 2. Construction: Tufted Textured Loop
- 3. Backing System: PVC WellBAC Comfort Cushion
- 4. Yarn System: Universal Fibers, Solution -Dyed Nylon
- 5. Color System: Solution Dyed

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6. Soil/Stain Protection: StainSmart®
7. Pile Thickness: 0.087 (2.21 mm)
8. Average Pile Density (finished): 6,700
9. Flammability (Radiant Panel ASTM-E648): 0.45(Class 1)
10. Smoke Density (NFPA-258-T or ASTM E662): Less than 450.
11. Methenamine Pill Test ((CPSC FF-1-70 or ASTM D2859): Self-Extinguishing
12. Total Recycled Content: 54 Percent, Pre-Consumer
13. Indoor Air Quality: CRI Green Label Plus #GLP7205, Carpet Category 13X
14. Embodied Carbon: 10.7 (kg CO₂e)/m

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints. (Verify if edge will allow for smoothest transition).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. 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.

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- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," 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, thresholds, and nosings. 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. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use non-permanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove yarns that protrude from carpet tile surface.
 - 2. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

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SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Interior surface preparation and painting, new and existing

1.2 RELATED DOCUMENTS

- A. Section 062023 – Interior Finish Carpentry
- B. Section 082120 - Wood Doors
- C. Section 012300 - Alternates

1.3 SUMMARY

- A. Section includes surface preparation and finish for the following:
 - 1. Gypsum board, plaster, new and existing.
 - 2. Hollow metal doors and frames.
 - 3. Exposed steel lintels, ductwork, pipes, ceiling joists and other structural components exposed to view.
 - 4. Access panels.
 - 5. Wood windows, sills and trim.
 - 6. Existing doors, frames and trim to be refinished.
 - 7. Coordinate finishing if interior architectural woodwork, specified in Section 064023.
 - 8. Exterior existing wood and window finish repairs.

1.4 SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

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1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Sherwin-Williams Company (The). (S-W)
 - 2. Benjamin Moore & Co. (Moore)
- B. Products: Subject to compliance with requirements, provide one of the products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, 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 shown on Drawing, Finish Schedules.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

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3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates. If labels are painted over, they shall be removed before Owner occupancy.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

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- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. 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.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. **Ferrous Metal Work, New and Existing:** Provide the following finish systems over interior ferrous metal. Primer is not required on existing and shop-primed items, except steel doors and frames which require an additional prime coat under this specification. Metal access panels. Prime bare spots of ferrous metals, existing and new. Provide a barrier (bond) coat over existing coatings after preparation for painting.
 - 1. Apply to exposed surfaces.
 - 2. Semigloss, Direct-to-Metal (D.T.M.) Acrylic Finish: 1 body coat and 1 finish coat over a corrosion resistant primer.
 - a. Primer, New: VOC compliant, quick-drying, corrosion resistant, metal primer applied at spreading rate recommended by the manufacturer to achieve a dry film thickness of not less than indicated for product.
 - 1) Moore: Super Spec HP28 Acrylic Metal Primer P04; 2.0 mils DFT.
 - 2) S-W: Pro-Industrial Pro-Cryl Universal Primer, B66-310 Series; 3.0 mils DFT.

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- a. Barrier (Bond) Coat on Existing Surfaces: Low-odor, low VOC, exterior barrier coat applied at spreading rate recommended by the manufacturer to achieve a dry film thickness of not less than indicated for product.
 - 1) Moore: Stix Waterborne Bonding Primer, SXA-110; 1.9 mils DFT.
 - 2) S-W: Extreme Bond Interior/Exterior Primer B51W00150 Series; 0.9 mils DFT.
 - c. Body and Finish Coats: Exterior, semigloss, low VOC, low odor, corrosion resistant, direct-to-metal coating applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
 - 1) Moore: Super Spec HP D.T.M. Acrylic Semi-Gloss P29; 3.0 mils DFT per coat.
 - 2) S-W: Pro-Industrial DTM Acrylic Semi-Gloss B66W01150 Series; 3.5 mils DFT per coat.
- B. Gypsum Board, New and Existing Plaster:** Provide the following finish systems over interior gypsum board surfaces:
- 1. Flat Acrylic Finish, GPDW Ceilings and Soffits, New and Existing:** 1 body coat and 1 finish coat over a primer.
 - a. Primer and Finish Coats, New and Patched Areas: Zero VOC, low odor, latex-based, interior primer applied at spreading rate recommended by manufacturer to achieve a dry film thickness of not less than indicated for product.
 - 1) Moore: Natura Interior Latex No. 112 (Self Priming or with Natura Primer No. 511); 1.8 mils DFT.
 - 2) S-W: Harmony Interior Acrylic, Primer & Flat Paint or SuperPaint Flat (self-priming, or with Premium Wall & Wood Primer) 1.5 mils DFT.
 - 2. (Semi-gloss) Finish, Walls (in General) New and Existing,**
 - 1) Moore: Natura Interior Latex No. 514 (Self Priming); 1.8 mils DFT.
 - 2) S-W: SuperPaint Interior (self-priming, or with Premium Wall & Wood Primer) 1.8 mils DFT.
 - 4. (Semi-gloss) Finish, Epoxy, Pre-Catalyzed: Toilet Rooms**
 - 3) Moore: Corotech V341 Pre-Catalyzed Waterbased epoxy, Low VOC (Self Priming); 1.8 mils DFT.
 - 6) S-W: 2 Coats Pro Industrial Pre-Catalyzed Waterbased Epoxy, B66-310 Series; 3.0 mils DFT, on 1 coat Promar 200 Zero VOC Primer.
- D. Wood, Opaque Finish:** Provide the following paint finish systems over interior wood surfaces:
Factory primed Wood Doors (body & finish coats only), **New and Existing Window sills and aprons, trim.** (Coordinate painting of new and existing wood surfaces) Refer to Section 012300 Alternates.

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1. Semigloss, Acrylic-Latex Finish: 1 finish coat over 1 body coat over a wood undercoater/primer.
 - a. Undercoater/Primer: Low odor, low or zero VOC, stain-blocking, acrylic-latex-based, interior wood undercoater, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a dry film thickness of not less than indicated for product.
 - 1) Moore: Fresh Start High-Hiding All-Purpose Primer No. 056; 1.4 mils DFT.
 - 2) S-W: Premium Wall & Wood Primer B28W08111 Series; 1.8 mils DFT.
 - b. Body and Finish Coats: Low odor, low or zero VOC, semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a dry film thickness per coat of not less than indicated for product.
 - 1) Moore: Ultra Spec 500 Semi-Gloss Finish No. N539; 1.8 mils DFT per coat.
 - 2) S-W: Harmony Interior Acrylic; 1.6 mils DFT per coat
- E. **Data, Telecommunication and Electrical Backboards** (where new are required): Provide the following finish over fire-retardant plywood:
 1. Flat Intumescent Finish, New: 1 body coat and 1 finish coat over a wood undercoater/primer.
 - a. Undercoater/Primer: Low odor, low or zero VOC, stain-blocking, acrylic-latex-based, interior wood undercoater/primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a dry film thickness of not less than indicated for product.
 - 1) Moore: Fresh Start High-Hiding All-Purpose Primer No. 056; 1.4 mils DFT.
 - 2) S-W: Preprite Problock Interior/Exterior Latex Primer\Sealer; 1.4 mils DFT.
 - b. Body and Finish Coats: Intumescent-type, fire-retardant paint applied at spreading rate recommended by manufacturer to achieve a total dry film thickness of not less than 4 mils; white color for telecommunication and black for electrical.
 - 1) Moore: P59 220 Latex Fire-Retardant Coating.
 - 2) S-W: FlameControl 20-20A Flat Latex Intumescent Coating.

END OF SECTION

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102100 – PLASTIC TOILET, SHOWER AND DRESSING COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid plastic toilet, shower and dressing compartments including the following
 1. Floor mounted overhead-braced toilet compartments.
 2. Shower and dressing compartments.

1.2 Delete any sections below not relevant to this project; add others as required.

- A. Section 05 50 00 - Metal Fabrications.
- B. Section 06 10 00 - Rough Carpentry.

1.3 REFERENCES

- A. ASTM A666 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. National Fire Protection Association (NFPA) 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Shop Drawings: Provide layout drawings and installation details with location and type of hardware required.
- D. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company regularly engaged in manufacture of products specified in this section, and whose products have been in satisfactory use under similar service conditions for not less than 5 years.

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- B. Installer Qualifications: A company regularly engaged in installation of products specified in this Section, with a minimum of 5 years experience.
- C. Materials: Doors, panels and pilasters, constructed from high density polyethylene (HDPE) resins. Partitions to be fabricated from polymer resins compounded under high pressure, forming a single component which is waterproof, nonabsorbent and has a self-lubricating surface that resists marks from pens, pencils, markers and other writing instruments. Cover all plastic components with a protective plastic masking.
- D. Performance Requirements:
 - 1. Fire Resistance: Partition materials shall comply with the following requirements, when tested in accordance with ASTM E 84, Class B:
 - a. Tested to Meet ASTM E84, Class B flame spread/smoke developed rating.
 - 2. Material Fire Ratings:
 - a. National Fire Protection Association (NFPA) 286: Pass.
 - b. International Code Council (ICC): Class B.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

- A. Manufacturer shall guarantee its plastic against breakage, corrosion, and delamination under normal conditions for 25 years from the date of receipt by the customer. If materials are found to be defective during that period for reasons listed above, the materials will be replaced free of charge. Labor not included in warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Scranton Products, which is located at: 801 E. Corey St.; Scranton, PA 18505; Toll Free Tel: 800-445-5148; Fax: 855-376-6161; Email: [request info \(info@scrantonproducts.com\)](mailto:request_info@scrantonproducts.com); Web: <http://www.scrantonproducts.com>
 - 1. Fabricator: Santana Toilet Partitions.
 - 2. Fabricator: Comtec Toilet Partitions.
 - 3. Fabricator: Capitol Toilet Partitions.
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 0160 00 - Product Requirements.

2.2 MATERIAL

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- A. Plastic Panels: High density polyethylene (HDPE) suitable for exposed applications, waterproof, non-absorbent, and graffiti-resistant textured surface.
- B. Zinc Aluminum Magnesium and Copper Alloy (Zamac): ASTM B 86.
- C. Stainless Steel Castings: ASTM A167, Type 304.
- D. Aluminum: ASTM 6463-T5 alloy.

2.3 SOLID PLASTIC TOILET COMPARTMENTS

- A. Basis of Design: Hiney Hiders Toilet Partitions as manufactured by and supplied by Scranton Products.
 - 1. Style: Floor mounted overhead-braced toilet compartments.
 - 2. Style: Shower and dressing compartments.
- B. Doors, Panels, and Pilasters: 1 inch (25 mm) thick with all edges rounded to a radius. Mount doors and dividing panels based on height of specified system.
 - 1. Door and Panel Height: 72 inches.
 - 2. Aluminum heat sink fastened to bottom edges.
 - 3. Door Design: Traditional 2600.
 - 4. Pilasters: 82 inches high and fastened to floor.
- C. Panel Color: Traditional series.
 - 1. Grey - Orange Peel.
- D. Pilaster Shoes: 3 inches, 20 gauge stainless steel. Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt.
- E. Pilaster Shoes: 3 inches high one-piece molded HDPE. Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt.
 - 1. Pilaster Plastic Shoe Color: Grey.
- F. Headrail: Heavy-duty extruded 6463-T5 alloy aluminum with anti-grip design. Finish to be clear anodized. Fastened to headrail brackets with stainless steel tamper resistant Torx head sex bolt, and fastened at the top of the pilaster with stainless steel tamper resistant Torx head screws.
 - 1. Headrail Brackets: 20 gauge stainless steel with satin finish. Secured to the wall with stainless steel tamper resistant Torx head screws.
- G. Wall Brackets:
 - 1. Stainless Steel Brackets: Stainless steel type 201.
 - 2. Brackets are fastened to pilasters with stainless steel tamper resistant Torx head screws and fastened to the panels with stainless steel tamper resistant Torx head sex bolts.
 - 3. bolts.
 - 4. Bracket Type: Stirrup stainless steel double ear.
- H. Door Hardware: To be issued by Addendum.

2.4 SOLID PLASTIC SHOWER AND DRESSING COMPARTMENTS

- A. Plastic privacy screens in shower room applications as detailed on Drawing A111.

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- B. Panels and Pilasters: 1 inch thick with edges rounded to a radius. Mount screens at 10 inches above the finished floor. Color: Grey.
 - 1. Recycled content: Minimum 25 percent.
- C. Type: Floor mounted pilaster supported screen.
 - 1. Panel Screens: 72 inches high.
 - 2. Pilaster Screens: 82 inches high.
 - 3. Headrail: Heavy-duty extruded 6463-T5 alloy aluminum with anti-grip design and integrated curtain track. Clear anodized finish. Fastened to the headrail bracket with a stainless steel tamper resistant Torx head sex bolt, and fastened at the top of the pilaster with stainless steel tamper resistant Torx head screws.
 - 4. Headrail Brackets: 20 gauge stainless steel with a satin finish. Secured to the wall with stainless steel tamper resistant Torx head screws.
 - 5. Pilaster Sleeves: 20 gauge stainless steel. 3 inches (76 mm) high. Secured to pilaster with stainless steel tamper resistant Torx head sex bolt.
 - 6. Wall Brackets: Continuous, heavy-duty 6463-T5 alloy aluminum. Clear anodized finish. Fastened to panel/pilaster with stainless steel tamper resistant Torx head sex bolts.
 - 7. Shower Curtains (at shower openings) : 42 x 72 inches, white non PVC, hung with aluminum curtain hooks with self-lubricating Delrin slides.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Examine areas to receive toilet partitions, screens, and shower compartments for correct height and spacing of anchorage/blocking and plumbing fixtures that affect installation of partitions. Report discrepancies to the architect.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install partitions rigid, straight, plumb, and level manor, with plastic laid out as shown on shop drawings.
- C. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed 3/8 inch.
- D. No evidence of cutting, drilling, and/or patching shall be visible on the finished work.

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- E. Finished surfaces shall be cleaned after installation and be left free of imperfections.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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SECTION 102800 – TOILET, BATH AND CUSTODIAL ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Toilet accessories.
 - 2. Shower room accessories.
 - 3. Custodial accessories.

1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Include electrical characteristics.
- B. Samples: Full size, for each exposed product and for each finish specified.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

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1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

- A. Owner-Furnished Materials: (**No substitutions**) The following accessories will be furnished by the Owner and installed by the Contractor:
 - 1. Toilet Tissue Dispenser.
 - 2. Toilet Seat Cover Dispenser
 - 3. Paper Towel Dispenser.
 - 4. Soap Dispenser.
 - 5. Dual Napkin/Tampon dispenser (NOT PLASTIC)

2.2 WASHROOM ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in this section or substitute product by one of the following:
 - 1. Bobrick
 - 2. American Specialties, Inc.

Toilet Tissue (Roll) Dispenser (**AC-8**): Impact #2519 Double Roll Dispenser

- B. Toilet Seat Cover Dispenser (**AC-9**): Kimberly Clark No. 09506.
- C. Paper Towel Dispenser (**AC-10**): San Jamar Ultrafold dispenser No. T1700White (tri-fold).
- D. Liquid-Soap Dispenser (**AC-7**): Spartan White Foamy No. 975700.
- E. Grab Bars, (Toilet Grab Bars **AC-6**) (Shower Grab Bars **AC-5**)
 - 1. Basis-of-Design Product: Bobrick No. B-5806 Series.
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 4. Outside Diameter: 1-1/4 inches.
 - 5. Configuration and Length: As indicated on Drawings.
- F. Sanitary Napkin/Tampon Dispenser: Dual Napkin/Tampon Dispenser HOSPECO D1-25C.
- G. Sanitary-Napkin Disposal Unit (**AC-11**):
 - a. Basis-of-Design Product: Rubbermaid 6140.
 - 6. Mounting: Partition-mounted.
 - 7. Door or Cover: Self-closing, disposal-opening cover.

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8. Receptacle: Removable.
 9. Material and Finish: Stainless steel, No. 4 finish (satin).
- F. Mirror Units:
1. Basis-of-Design Product: Bobrick No. B-165.
 2. Frame: Stainless-steel channel.
 - a. Corners: Mitered.
 3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
 4. Sizes:
 - a. Type **AC-1**: 24 x 42 inches.
 - b. Type **AC-3**: 24 x 72 inches.
- G. Robe Hook: (**AC-12**)
1. Basis-of-Design Product: Bobrick B-6727.
 2. Description: Single-prong unit.
 3. Material and Finish: Stainless steel, No. 4 finish (satin).
- H. Wall Mounted Trash Bin, Recessed (**AC-4**): Bobrick B-35633 Commercial Waste Receptacle, stainless steel, satin finish. Size 16"w x 29 1/4" h x 4" d.

2.3 SHOWER ROOM ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in this section or substitute product by one of the following:
1. American Specialties, Inc.
 2. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
- B. Shower Curtain Rod: Integral with Toilet Partitions
- C. Shower Curtain: Specified with Toilet and Shower Partitions.
- D. Folding ADA Shower Seat:
1. Basis-of-Design Product: Bobrick No. B-5181.
 2. Configuration: L-shaped seat, designed for wheelchair access.
 3. Seat: Solid phenolic seat.
 4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).

2.4 CUSTODIAL ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in this section or substitute product by one of the following:
1. American Specialties, Inc.
 2. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

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- B. Mop and Broom Holder:
 - 1. Basis-of-Design Product: Bobrick No. B-223 x 36.
 - 2. Description: 0.0375-inch thick, stainless-steel hat channel with four spring-loaded, rubber, cam-type, mop/broom holders.
 - 3. Length: 36 inches.
 - 4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).

2.5 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.6 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to 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.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

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3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION

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SECTION 104400 – SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior signage of the following types:
 - 1. ADA compliant interior signage, without borders.
 - 2. New ADA Signage: Toilet Rooms, Stairs, Landings, Exits, Elevator, Directional Signage for ADA Entrances.
 - 3. Fire evacuation signs

1.2 REFERENCES

- A. ANSI/ICC A117.1 - Accessible and Useable Buildings and Facilities; 2003.
- B. ATBCB ADAAG - Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG); U.S. Architectural Transportation Barriers Compliance Board; 2004.

1.3 SUBMITTALS

- B. Product Data: Manufacturer's descriptive and technical specifications.
- C. Shop Drawings: List sign styles, lettering, locations and dimensions of each interior sign.
- D. Selection Samples: One complete set of color chips representing manufacturer's full range of available colors.
- E. Verification Samples: Two full size samples, representing type, style and color specified including method of attachment.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of ANSI/ICC A117.1 and ADAAG.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inspect products upon receipt. Store products in manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Welch Sign, welchsign.com.

2.2 INTERIOR SIGNS

- A. ADA-Compliant Interior Signage, Borderless:
 - 1. Style: _____.
 - 2. Type: _____.
 - 3. Sign Thickness: 1/8 inch thick or 1/4 inch thick as required.

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4. Construction: _____
 5. Lettering Style: Helvetica Medium, upper case.
 6. Braille: Grade 2 Braille, placed directly below last line of letters or numbers.
 7. Performance: Non-static, fire-retardant, and self-extinguishing.
 8. Contrast: Letters numbers and symbols shall contrast with background.
 9. Corners: Square with small radius.
 10. Color of Plastic: As selected from manufacturer's standard colors.
 11. Finish of Plastic: Matte.
 12. Color of Background: As selected from manufacturer's standard paint colors.
 13. Letter and Number Sizes:
 - a. Room numbers and floor name on floor module, 7/8 inch high.
 - b. Lettering for restroom identification, 7/8 inch high; corresponding symbols 4 inches high; symbol on symbol only signs minimum 3-1/2 inch high.
 14. Sign Margins: Letters and numbers, 1/2 inch left margin and 3/8 inch top margin.
 15. Sign Sizes:
 - a. Restroom and symbol signs, 8 by 8 inches.
 - b. Room identification signs, 9-1/2 by 4-3/4 inches.
- B. Fire Evacuation, Specialty Signs: Provide signage at egress doors into stairs and at elevator; no new signage within stairs.
1. Style: Fire Evacuation Signs by Vista Systems, or approved equal.
 2. Lettering Style: Typeface as selected, upper case.
 3. Lettering Location: Centered on sign.
 4. Corners: As selected.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine installation areas to ensure that conditions are suitable for installation.
- B. Examine signage for defects prior to installation. Do not install damaged signage.

3.2 PREPARATION

- A. Verify mounting heights and locations for interior signage will comply with referenced standards.
- B. Clean mounting locations of dirt, dust, grease or similar conditions that would prevent proper installation.

3.3 INSTALLATION

- A. Install signs level, plumb, without distortion, and in proper relationship with adjacent surfaces using manufacturer's recommended standard mounting system.
 1. Mounting: Mount with vinyl foam tape.
- B. Remove adhesive from exposed sign surfaces as recommended by manufacturer.
- C. Clean signs after installation as recommended by manufacturer.
- D. Replace damaged products before Substantial Completion.

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END OF SECTION

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SECTION 104416 - FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers, cabinets, and mounting brackets for fire extinguishers.

1.2 PREINSTALLATION MEETINGS

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.

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2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.

1. Manufacturers:

- a. J.L. Industries, Inc., a division of Activar Construction Products Group
- b. Larsons Manufacturing Co.
- c. Potter Roemer, LLC.

Source Limitations: Obtain fire extinguishers and accessories, from single source from single manufacturer.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:80-B:C, 10-lb with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 FIRE-PROTECTION CABINETS

- A. Cabinet Type: Suitable for specified fire extinguisher.

1. Available Products: Subject to compliance with requirements, provide one of the following.
 - a. J.L. Industries: Cosmopolitan Series C8137F17.
 - b. Larsen's: Architectural Series SS 2409-6R.
 - c. Potter-Roemer: Alta Series 7062-A-4.

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- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Cold-rolled steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Semi-recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 1. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Materials:
 - 1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel or powder coat.
 - b. Color: White.
 - 2. Stainless Steel: ASTM A 666, Type 304.
 - a. Finish: No. 4 directional satin finish.
 - 3. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 IDENTIFICATION

- A. Identification for Mounting Brackets: Projecting sign with lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - 1. Available Products:
 - a. PTD-182 by Larsen.
 - b. PTD109 by J.L. Industries.

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2. Location: Applied to wall above extinguisher.
3. Application Process: Pressure-sensitive tape or screw fasteners.
4. Lettering Color: White on red background with graphic of fire extinguisher and arrow pointing down.

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 MOUNTING BRACKETS

- A. Mounting Brackets (At locations without a cabinet): Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
- B. Identification for Mounting Brackets: Projecting sign with lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
1. Available Products:

PTD-182 by Larsen.
PTD109 by J.L. Industries.
 2. Location: Applied to wall above extinguisher.
 3. Application Process: Pressure-sensitive tape or screw fasteners.
 4. Lettering Color: White on red background with graphic of fire extinguisher and arrow pointing down.

2.6 GENERAL FINISH REQUIREMENTS

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- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Install fire-protection cabinets, level and plumb, 54 inches above finished floor to top of cabinet, in strict accordance manufacturer's instructions.
- C. Identification: Install identification above fire extinguisher cabinet.

3.2 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

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- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 122413 – ROLLER WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manually operated, roll-up fabric interior window shades including mounting and operating hardware.

1.2 RELATED SECTIONS

- A. Section 092216 – Non-Structural Metal Framing: Blocking for support of window shade hardware.
- B. Section 079200 - Joint Sealants: Sealants for perimeter of shade system.

1.3 REFERENCES

- A. GREENGUARD Environmental Institute Children & Schools.
- B. US Green Building Council.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product specified, including:
 - 1. Preparation instructions and recommendations.
 - 2. Installation and maintenance instructions.
 - 3. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
 - 4. Storage and handling requirements and recommendations.
 - 5. Mounting details and installation methods.
- B. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances and relationship to adjacent work.
- C. Window Treatment Schedule: See Interior Finish Schedules for locations of all roller shades. Use same room designations. Field verified window dimensions, quantities, type of shade, controls, fabric, and color, and include opening sizes and key to typical mounting details.
- D. Selection Samples: For each finish product specified, two complete sets of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.
- E. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.
- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

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1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer.
- B. NFPA Flame-Test: Passes NFPA 701. Materials tested shall be identical to products proposed for use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.
- B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
- C. Label containers and shades according to Window Shade Schedule.
- D. Store products in manufacturer's unopened packaging until ready for installation.

1.7 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 PROJECT CONDITIONS

- A. Install roller shades after finish work and ambient temperature, humidity and ventilation conditions are maintained at levels recommended for project upon completion.

1.9 WARRANTY

- A. Hardware and Shade Fabric: Twenty-five year limited warranty.
- B. Spring Roller Shades: Ten year limited warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Draper, Inc. or equal by Mecho Shades Inc.,

2.2 MANUALLY OPERATED WINDOW SHADES

- A. Manually Operated Window Shades with Independent Control: Manually operated, vertical roll-up, fabric window shade with components necessary for complete installation; Manual FlexShade as manufactured by Draper, Inc.
 - 1. Operation: Bead chain and clutch operating mechanism allowing shade to

- stop when chain is released. Designed never to need adjustment or lubrication. Provide limit stops to prevent shade from being raised or lowered too far.
- a. Clutch mechanism: Fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon.
 - b. Bead chain loop: Stainless steel bead chain hanging at side of window.
 - c. Idler Assembly: Provide roller idler assembly of molded nylon with adjustable length idler pin to facilitate easy installation, and removal of shade for service.
2. Mounting:
 - a. Mounting brackets.
 3. Roller Tube: Fabricated from extruded aluminum, galvanized steel, or enameled steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade type and size. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.
 4. Brackets: Plated stamped steel. Provide size compatible with roller size.
 - a. Mounted to jamb.
 5. Shade slat: Slat encased in heat seamed hem.
 6. Wall Clip with Closure panel: For site constructed ceiling recesses, provide removable closure panel to minimize slot for shade passage but allowing access to shade for maintenance.
 - a. Material: Aluminum alloy with white epoxy paint finish.
 - b. Provide continuous wall clip, 1-13/16 (45 mm) by 1/4 inch (6 mm), for snap-in attachment of closure panel without fasteners.

2.3 FABRIC

- A. Light-Filtering Fabrics
 1. Mermet E-Screen 7503, Green Guard Certified 36 percent fiberglass/64 percent vinyl fabric weave with a 3 percent openness factor. Color to be selected by Architect.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

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- B. Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.
- C. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
 - 1. Fascias.

3.4 TESTING AND DEMONSTRATION

- A. Test window shades to verify that operating mechanism, fabric retainer, and other operating components are functional. Correct deficiencies.
 - 1. Chain and clutch.
- B. Demonstrate operation of shades to Owner's designated representatives.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 SCHEDULES

- A. Refer to Drawings, interior finish schedule for shade locations.

END OF SECTION

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SECTION 211000 - FIRE-SUPPRESSION SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The fire protection system scope shall provide extensions and alterations to the existing wet pipe automatic sprinkler system within the facility as required to facilitate the renovations. System design shall be automatic sprinkler system arranged to properly protect the building and shall meet NFPA 13, local, and State requirements. Alterations and extensions to the existing system shall include but not necessarily be limited to the following:
 - 1. Relocate the existing 4” sprinkler riser serving the third and fourth floor areas as required to facilitate the new chase location.
 - 2. Revise the main and branch piping and head layout throughout the third floor area to facilitate the renovations.
 - 3. Revise and relocate the piping and head layout at the fourth floor shell space to facilitate the renovations.
 - 4. Add sprinkler coverage as required for new soffits at the third and fourth floor areas.
 - 5. Provide alterations and extensions as required at the second floor area to accommodate removal and replacement for the existing suspended acoustical tile ceilings.
- B. This Section includes fire-suppression sprinklers, piping, and equipment.
- C. The Sprinkler Contractor shall place the sprinkler system in service and hand over the sprinkler system to the General Contractor for care and maintenance.
- D. Performance and Design Criteria: Provide products and systems complying with specific performance and design criteria indicated.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design sprinklers and obtain approval from authorities having jurisdiction. The design of the automatic sprinkler system shall be complete with all necessary accessories for proper operation.
- B. The system shall be hydraulically calculated in accordance with all provisions of the Contract Documents and any authority having jurisdiction.

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- C. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:
 - 1. Include a 5 percent margin of safety for available water flow and pressure.
 - 2. Include losses through water-service piping, valves, and backflow preventers.
- D. Sprinkler Occupancy Hazard Classifications:
 - 1. Light Hazard:
 - a. Office and Public Areas
 - b. Corridors
 - c. Residential living areas
 - 2. Ordinary Hazard, Group 1:
 - a. General Storage Areas
 - b. Mechanical Equipment Rooms
 - c. Building Service Areas.
 - d. Electrical Equipment Rooms
- E. Minimum Density for Automatic-Sprinkler Piping Design shall be in accordance with NFPA 13. Maximum Protection Area per Sprinkler shall be in accordance with NFPA 13.

1.4 GENERAL REQUIREMENTS

- A. Components and Installation: Capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.
- B. Protect all systems from freezing. Provide freeze protection for sprinklers in unheated areas with a dry pipe system.
- C. Bundled/Grouped wired in concealed spaces: Non-combustible spaces having 15 or more non-plenum-rated wires grouped together shall be fully sprinklered.
- D. Seismic Performance: If required by the authority with jurisdiction, fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.
- E. Elevators: Provide sprinkler protection in accordance with authority with jurisdiction requirements.
- F. Coordinate fire department connection type and location with local fire department.
- G. The sprinkler contract starts inside the sprinkler valve room with a connection to the water entry. Coordinate with the site contractor.

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- H. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 7 for materials. Seal all penetrations through fire-or smoke-rated wall, partition, ceiling, or roof assemblies with firestopping system. Refer to Architectural plans for location of rated assemblies.
- I. Contractor shall obtain and pay for required permits.

1.5 SUBMITTALS

- A. Shop Drawings: Submit working plans, prepared according to NFPA 13, and hydraulic calculations with cross reference to applicable drawings, water supply data, and equipment schedule with ratings for the system to the Owner's Representative, Insurance Underwriter, and other authorities having jurisdiction.
- B. Product Data: Catalog sheets, specifications, and installation instructions. Indicate UL or FM approval for each product. Include the following additional information:
 - 1. Pipe and fitting materials and methods of joining for sprinkler piping.
 - 2. Pipe hangers and supports.
 - 3. Piping seismic restraints.
 - 4. Valves, including specialty valves, accessories, and devices.
 - 5. Alarm devices. Include electrical data.
 - 6. Electrical Devices: Complete description of intended use, wiring diagrams, data plate information and, in the case of switching devices, whether normally on or normally off. Include motor test data.
 - 7. Mechanical Devices: Complete description of intended use, including normal operating capacities and working pressures.
 - 8. Enclosures: Dimensions, materials, gages of metals; type of door hinges and locks, and methods of securing the enclosure members to the building construction.
 - 9. Hose Threads: Verify that hose threads on fire department connections match threads on equipment used by the local or servicing fire department.
- C. Design Data: The portions of the sprinkler system not sized on the Contract Drawings shall be sized in accordance with NFPA requirements for Hydraulically Designed Systems. Submit drawings and hydraulic calculations for approval.
- D. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible sprinkler system design professional. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Certification: Submit Contractor's NICET certification and number or PE license number.
- E. Field Test Reports and Certificates: 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" and "Contractor's Material and Test Certificate for Underground Piping."

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- F. Maintenance Data: For each type of sprinkler specialty to include in maintenance manuals specified in Division 1.

1.6 QUALITY ASSURANCE

A. Sprinkler Contractor

1. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.
2. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified sprinkler designer. Sprinkler designer shall be legally qualified and licensed 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 fire-suppression piping that are similar to those indicated for this Project in material, design, and extent.
3. Contractor shall be a licensed fire sprinkler contractor.

B. Manufacturer Qualifications:

1. Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.
2. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
4. Factory Mutual Engineering Corporation (FM) Approval Guide

C. NFPA Requirements: Year edition per authority of jurisdiction.

1. NFPA #1: Fire Prevention Code
2. NFPA #13: Standard for the Installation of Sprinkler Systems
3. NFPA #101: Life Safety Code

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8.

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- D. Coordinate sprinkler head layout and layout with all other trades.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Sprinkler Cabinets: Finished, wall-mounting steel cabinet and hinged cover, with space for a minimum of six spare sprinklers plus sprinkler wrench. Include the number of sprinklers required by NFPA 13 and wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 PIPING

- A. Pipe and fittings shall conform to the requirements of NFPA 13. Pipe shall be listed by UL and be FM approved, and installed per its listing and approval.
- B. Wet sprinkler piping shall be:
 - 1. Black steel Schedule 40 for 1 inch and smaller, and Schedule 10 for 1-½ inch and larger.
- C. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in N.F.P.A. 13. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application.
- D. Provide joining materials in accordance with NFPA 13.
- E. Transition Couplings: AWWA C219, sleeve type, or other manufactured fitting the same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.2 SPRINKLERS

- A. Fire sprinklers shall be of one manufacturer throughout the building. No mixing of sprinkler brands shall be permitted. Sprinklers shall be of all brass frame construction with a quick response frangible bulb type fusible element.
- B. Automatic Sprinklers: With U.L. listed heat-responsive elements.
- C. Sprinkler Types and Categories: Provide per NFPA 13.
- D. Provide quick response sprinklers.
- E. Institutional Semi-Recessed or "Vandal-Resistant" sprinkler heads as required by application.

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- F. Sprinkler Escutcheons: Materials, types, and finishes of sprinklers. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
- G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.3 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
- F. Contractor Option: Provide flexible sprinkler hose with fittings intended for use in sprinkler systems between the branch line and sprinkler. Provide in accordance with NFPA 13 and the manufacturer's installation instructions. Length: 38".
 - 1. U.L. 2443 listed for sprinkler hose application.
 - 2. Flexible Hose: Corrugated Stainless Steel AISI 304
 - 3. Slip Nuts: Brass C3771BC
 - 4. Reducer Fitting: Yellow Zinc/Steel SPPS
 - 5. Special Shoulder Nipple (Inlet): Yellow Zinc/Steel SPPS
 - 6. Reducing Nipple Clamp & Bolt: Galvanized Steel SS41
 - 7. Maximum Working Pressure of Flexible Connection: 200 PSI
 - 8. Test Pressure of Flexible Connection: 400 PSI
 - 9. Maximum Temperature Rating of Flexible Connection: 300 °F
 - 10. Provide ceiling bracket.

2.4 VALVES

- A. Valves shall be UL listed and FMG approved
- B. An NFPA-13 compliant setup including a backflow device, system control valve, flow switch, inspectors test, drain, and pressure gauge may be provided in lieu of an alarm valve.
- C. System Control Valve: The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and Factory Mutual Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI.

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- D. Manual or automatic air venting valve to exhaust trapped air in the wet sprinkler system.
- E. 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.

2.5 WATERFLOW ALARMS

- A. Flow of water equal to or greater than that from a single automatic sprinkler (smallest orifice in system) shall result in an audible alarm on the premises within 5 minutes after such flow begins and until such flow stops.
- B. The alarm apparatus shall consist of a listed alarm check valve or other listed waterflow-indicating device with the necessary attachments to give an alarm.

PART 3 - EXECUTION

3.1 EXISTING SYSTEMS

- A. Refer to Division 1 demolition requirements and procedures. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.
- B. Existing Sprinkler System Shutdown: Follow NFPA 13 and NFPA 25 recommendations. Before shutting down the sprinkler system to perform the Work, notify the Owner's Representative in writing, the local fire department, and the alarm company, that the system is to be shut down temporarily. Give schedule which states date and time of proposed shut down and the approximate length of time that the system will be out of service. Request instructions for precautions that should be taken during the shutdown period. Do not shut down the system until schedule is approved by the Owner's Representative. Return the existing system to pre-shutdown operation immediately after the Work has been completed. Give written notice to the Director's Representative that the system has been returned to pre-shutdown operation.

3.2 PREPARATION

- A. The nature of the work requires coordination with other trades. Shop fabrication shall be done at the Contractor's risk. Relocation of piping and components to avoid obstructions may be necessary. Relocation, if required, shall be done at the Contractor's expense. The installation shall be performed in a workmanlike manner as determined by the Owner's Representative and in accordance with the Contract Documents, manufacturer's printed installation instructions, and submitted and Owner's Representative reviewed drawings.

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3.3 SPRINKLER APPLICATIONS

A. General: Use sprinklers according to the following applications:

1. Rooms/spaces without Ceilings: Upright sprinklers.
2. All occupied rooms with Finished Ceilings: Concealed.
3. Provide sprinkler guards for heads in mechanical and storage spaces, less than 8 ft. above finished floor subject to mechanical damage.
4. Low ceilings (under 8 feet): Concealed
5. Electrical or Data Rooms with finished ceilings: Concealed
6. Electrical or Data Rooms without ceilings: Provide guard
7. Wall Mounting: Sidewall sprinklers.

B. Finishes

- a. Unfinished spaces not exposed to view: rough bronze.
- b. Sprinklers: White
- c. Provide escutcheons with matching color for finished spaces.

3.4 SYSTEM INSTALLATIONS

- A. Earthquake Protection: Provide piping according to NFPA 13 to protect from earthquake damage.
- B. Water supply control valves shall be electrically supervised and mechanically locked for proper position. Water flow and supervisory circuits shall be in accordance with the requirements of electrical specifications. Electric connections to sprinkler system shall be by Division 26. Furnish wiring diagrams for all equipment.
- C. Fire Department Connection: A system fire department connection shall be provided on the system riser in accordance with N.F.P.A. 13. Fire department connection shall be installed in an area accessible for the first response unit. Coordinate with local fire department.
- D. A sprinkler head wrench of each style and model installed shall be provided to the owner at the completion of the project. A representative sampling of each sprinkler head style and model shall be provided to the owner and housed in a sprinkler head cabinet at or near the sprinkler riser. The number of sprinkler heads provided to the owner shall be in accordance with NFPA 13.
- E. Provide "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13
- F. Provide a vent near a high point in the system to allow air to be removed from that portion of the system.

3.5 SPRINKLER INSTALLATION.

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- A. Provide sprinklers in suspended ceiling in center of all ceiling tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space per NFPA 13.
- C. Provide sprinkler piping with drains for complete system drainage.
- D. Hangers and Supports: Comply with NFPA 13 for hanger materials.

3.6 LABELING AND IDENTIFICATION

- A. Provide labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.7 FIELD QUALITY CONTROL

- A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- C. Verify that specified tests of piping are complete.
- D. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- E. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- F. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- G. Fill wet-pipe sprinkler piping with water.
- H. Energize circuits to electrical equipment and devices.
- I. Coordinate with fire alarm tests. Operate as required.

3.8 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers having paint other than factory finish.
- C. Clean and disinfect fire-suppression water-service piping as follows:

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1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651.
4. Prepare reports.

3.9 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.10 PROTECTION

- A. Protect sprinklers from damage until Substantial Completion.

END OF SECTION 210000

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SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 230700 for plumbing insulation.

END OF SECTION 220700

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SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section: "Common Work Results"

1.2 SUMMARY

- A. This Section includes domestic water piping and specialties.

1.3 ACTION SUBMITTALS

- A. Product Data: For domestic water piping, fittings, valves and accessories.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with the local building and plumbing codes.
- C. Qualify brazing processes for copper and copper alloy pipe and tube according to ANSI/AWS C3.4.
- D. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
- E. Comply with NSF 372 for low lead.

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PART 2 - PRODUCTS

2.1 COPPER TUBING

- A. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 - 3. 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.
 - 4. Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
- B. Mechanically formed copper tee connections are not acceptable.
- C. Viega Pro Press Fittings: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect) feature design (leakage path). The Smart Connect Feature shall assure leakage of liquids and/or gases from inside the system past the sealing element of an un-pressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

2.2 PEX PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. PEX-a manufacturer system warranty shall cover tubing for a duration of 30 years from the date of installation.
 - 1. Uponor AquaPEX (Basis of Design)
 - 2. Rehau
 - 3. Watts Radiant
 - 4. Viega
- B. Manufacturer's Warranty for Piping and Fittings: PEX-a manufacturer system warranty shall cover piping and fittings for a duration of 25 years from the date of installation. Piping system warranty shall apply to potable water distribution and water service systems constructed of pipe and fitting products sourced from the same manufacturer.
- C. PEX-a (Engel-Method Crosslinked Polyethylene) Piping: ASTM F 876 and F877 (CAN/CSA-B137.5).

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- D. PEX-a Fittings: elbows, adapters, couplings, plugs, tees and multi-port tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
 - 1. Lead-free (LF) Brass.
 - 2. 20% glass-filled polysulfone as specified in ASTM D 6394.
 - 3. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D 6394.
 - 4. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D 6394.
 - 5. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D 6394.
 - 6. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".
- E. Multiport tees and elbows: Multiple-outlet fitting complying with ASTM F877 (CAN/CSA B137.5); with ASTM F1960 inlets and outlets.
- F. Manifolds: Multiple-outlet assembly complying with ASTM F 877 (CAN/CSA B137.5); with ASTM F 1960 outlets.
- G. PEX Transition Fittings: Provide fittings from the same manufacturer of the piping.

2.3 SCHEDULE 80 CPVC PIPING

- A. CPVC Schedule 80 IPS pipe and fittings shall be compatible, extruded/molded/fabricated using Corzan compound and be produced by one manufacturer as supplied by IPEX or Georg Fischer. CPVC Schedule 80 IPS pipe shall conform to ASTM F441/F441M and be third party certified to NSF 14 and NSF 61. CPVC Schedule 80 IPS pipe shall be made with a CPVC compound having a minimum cell classification of 24448 for diameters less than 8 inch, and cell classification of 24447 for diameters 8 inches and above. Pipe shall be of 10- or 20-foot lengths.
- B. CPVC Schedule 80 IPS fittings must be third party certified to NSF 14 and NSF 61. CPVC Schedule 80 IPS fittings shall be molded/fabricated with Corzan compound and meet a minimum cell classification of 24448 for diameters less than 8 inch, and cell classification of 24447 for diameters 8 inches and above.
 - 1. CPVC Schedule 80 socket fittings shall conform to ASTM F439.
 - 2. CPVC Schedule 80 threaded fittings shall conform to ASTM F437.
 - 3. CPVC flanges shall have a 150-lbs bolt pattern as per ANSI B16.5 and conform to ASTM F1970 with pressure ratings of 150psi at 73°F.
 - 4. CPVC Schedule 80 unions socket shall conform to ASTM F439 and meet ASTM F1970 with pressure ratings of 150 psi at 73°F.
 - 5. CPVC one-piece ball valves & threaded adapters shall meet ASTM F1970 with pressure ratings of 400 psi at 73°F and 100 at 180°F.
 - 6. CPVC Schedule 80 adapters may be manufactured by Sioux Chief or NIBCO using Corzan compound.
- C. All socket type joints shall be assembled with solvent cements that meet or exceed the requirements of ASTM F493 and primers that meet or exceed the requirements of ASTM F656.

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Safe handling of solvent cements shall be in accordance with ASTM F402. Solvent cement and primer shall be listed by NSF International for use with potable water and approved by the pipe and fittings manufacturers.

- D. Corzan pipe and fittings have been listed by ICC-ES under PMG 1264. The following models have been tested water filled or dry in general accordance with UL 723/ASTM E84 test methods for surface burning characteristics and have been found to meet the 25/50 flame spread/smoke developed requirements of the IMC and UMC for installation in ducts and plenums.
1. 1/2" – 6" water filled Corzan® CPVC pipe and fittings have a flame spread index of 0 and a smoke developed index of no more than 20.
 2. 1/2" – 2" dry Corzan CPVC pipe and fittings for condensate lines have a flame spread index of 0 and a smoke developed index of no more than 20
- E. The contractor shall use ancillary building products (including, but not limited to fire stops, thread sealants, leak detectors, etc.) that are chemically compatible with Corzan CPVC compounds.

2.4 STAINLESS-STEEL PIPING

- A. Potable-water piping and components shall comply with NSF 61 Annex G.
- B. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 10 and Schedule 40.
- C. Stainless-Steel Pipe Fittings: ASTM A 815/A 815M.

2.5 VALVES & STRAINERS

- A. Ball Valves
1. The valve body and adapter shall be constructed using Lead Free brass. Lead Free ball valves shall comply with state codes and standards, where applicable, requiring reduced lead content.
 2. 1/2" to 2" ball valves: 2-piece full port lead-free brass ball valves: The valve must have a blowout proof pressure retaining 316 stainless steel stem, 316 stainless steel ball, virgin PTFE seats, seals, stem packing seal and thrust washer. Valve must have adjustable packing. Valves with O-ring stem seal only are not acceptable. Pressure rating no less than 600psi WOG non-shock, 150psi WSP. Valve shall be manufactured to the MSS-SP-110 standard and shall be a Watts Series LFB6080 (threaded) or LFB6081 (solder).
 3. Valve sizes 2-1/2" to 4" threaded, shall be rated to 400psi WOG non-shock and 125psi WSP. Valve sizes 2-1/2" to 3" solder shall be rated to 400psi WOG non-shock and 125psi WSP. Valve shall be a Watts Series LFFBV-3C (threaded) or LFFBVS-3C (solder).
 4. Provide locking handle where indicated.
 5. Comply with MSS SP-110.

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B. Swing check valves:

1. Construct pressure containing parts of Valves as follows: Bronze Valves: 125 or 150 psi: ANSI/ASTM B 62; Iron Body Valves: ANSI/ASTM A-126, Grade B.
2. Check valves shall be lead free.
3. Comply with the following standards for design, workmanship, material and testing: Bronze Valves: MSS SP – 80; Cast Iron Valves: MSS SP – 71
4. Construct valves of pressure casting free of any impregnating materials. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
5. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc.
6. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc.
7. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, horizontal swing, cast-iron disc.

C. Y-type strainer (3" and smaller) Wye-pattern Lead Free Bronze (cast copper silicon alloy strainer) shall be domestically manufactured and conform to Buy American Act standards. The strainer must have a solid retainer cap with gasket. Strainer shall be rated to 400psi (27.6 bar) WOG @ 210°F; 125psi WSP @ 353°F for sizes 1/4"- 3". The strainer screen shall be 304 stainless steel, 30 mesh. Strainer shall be a Watts Series LF777 (threaded ends) or LFS777 (solder ends).

D. 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.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: match piping.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.6 BACKFLOW PREVENTERS

A. Manufacturers:

1. Zurn Industries, Inc.; Wilkins Div.
2. Cla-Val Co.
3. Apollo
4. Febco Backflow Preventers.
5. Watts Industries, Inc.
6. Ames

B. General: ASSE standard, backflow preventers.

1. NPS 2 and Smaller: Bronze body with threaded ends.
2. NPS 2-1/2 and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.

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3. Interior Components: Corrosion-resistant materials. AWWA C550 or FDA-approved
 4. Exterior Finish: manufacturer's standard.
 5. Provide ball valves on inlet and outlet
 6. Provide strainer on inlet.
 7. All components shall be lead free.
- C. Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
- D. Double-Check Backflow Prevention Assemblies:
1. Watts 007M2QT-S (2" and smaller)
 2. ASSE 1015, suitable for continuous pressure application. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
- E. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Pressure Loss: 12 PSIG maximum, through middle 1/3 of flow range.
1. Provide air gap fitting.
 2. Watts 009-FS - (2" and smaller)

2.7 FLOW SPLITTER

- A. Multi-looped system for providing constant hot water circulation to plumbing fixtures utilizing a dynamic, self-regulating Flow-Splitter valve. Manufacturers: Kemper, or equal.
- B. Kemper Venturi Flow-Splitter Series 651 06 xxx: Lead-free, corrosion resistant red brass dual tee assembly valve with internal, self-adjusting flow regulator including factory loop line ¼ turn shut off valves and factory insulation jacket. When installed per manufacturer's recommendation will provide constant circulating hot water through looped piping to plumbing fixtures to maintain domestic hot water loop temperatures and minimize non-circulating pipe lengths to within required IECC and FGI code specifications.
1. Low lead, zinc resistant red brass.
 2. Available in sizes from ½" to 2" in the main flow portion of the valve.
 3. Incorporates a dynamic built-in, self-regulating, self-cleaning, flow diverting POM cartridge insert with SS spring and EPDM O-ring.
 4. NSF 61/372 certified.
 5. Configured with female NPT thread connections and 1/4 turn full bore stop valves on loop line connections.
 6. Maximum operating temperature 194°F.
- C. Provide potable water loop circulation system with Flow-Splitter in accordance with construction drawings and factory recommendations. Valve to be installed according to flow direction indicator.
- D. Circulation loop piping from primary hot water source at the Flow-Splitter shall be run to connection points of angle stops serving fixtures and to tub or tub/shower points of connection

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returning to the Flow-Splitter/hot water source piping. Non-circulation portions of piping shall be no more than 24 inches in length.

2.8 THERMOSTATIC WATER MIXING VALVES

A. Manufacturers:

1. Armstrong International, Inc.
2. Lawler Manufacturing Company, Inc.
3. Leonard Valve Company.
4. Powers
5. Symmons Industries, Inc.

B. To prevent scalding, an ASSE-1070 TMV shall be provided for hand wash sinks and lavatories. A separate TMV is not required if a code-compliant TMV is built-in to the faucet. Set at 110°F. Install as close as practical to the point of use.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model ZW3870XLT (Lead-Free) or Model ZW1070XL (Lead-Free).
2. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable 95-115°F
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Design Flow Rate: 0.35 GPM minimum.
9. An ASSE-1017 TMV shall be provided at the water heater (water stored at 140°F) to

2.9 DHW RECIRCULATION BALANCING VALVES

A. Provide as part of the potable hot water recirculation system in accordance with construction drawings and factory recommendations. Balancing valve shall be installed on domestic hot water return piping downstream of the last fixture with suitable access panel as required in non-accessible ceilings and walls.

B. ThermOmegaTech “Circuit Solver”; Caleffi “Thermosetter”, Viega, Kemper, or approved equal.

1. Balancing valves shall be self-contained and fully automatic without additional piping or control mechanisms.
2. Balancing valves shall regulate the flow of recirculated domestic hot water based on water temperature entering the valve regardless of system operating pressure.
3. When fully closed valve shall bypass a minimum flow to maintain dynamic control of the recirculating loop and provide a means for system sanitizing.
4. Valve shall be factory adjustable from 105°F to 140°F as required by project conditions. Valve shall modulate between open and closed position within a 10°F range.

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5. Provide the CSUSF model that allows for an additional balancing cycle at 170°F. The valve shall start to re-open above the low temperature balancing set point to allow the system to rebalance at the sanitizing flush temperature.
6. Valve body and all internal components shall be constructed of stainless steel with major components constructed of type 303 stainless steel.
7. Valve shall be rated to 200 PSIG maximum working pressure. Valve s shall be rated to 300°F maximum working temperature.
8. Valves shall be standard tapered female pipe thread, NPT.
9. Valve shall be ANSI/AWWA C800 compliant and shall be NSF-61 certified with zero lead content for use in all domestic water systems.
10. Thermal actuator shall be spring operated and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits. Thermal actuator shall be rated for a minimum of 200,000 cycles.

C. Provide the following with the balancing valves either built-in:

1. Upstream: shutoff valve and 20-mesh strainer.
2. Downstream: shutoff valve and threaded temperature port with threaded plug.

2.10 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Watts
2. Oatey
3. Precision Plumbing Products, Inc.
4. Sioux Chief
5. Zurn

B. Watts LF15M2-DR Series: lead-free, pre-charged copper water hammer arrestor with polypropylene piston, EPDM O-ring seal, and brass NPT threaded connection. ASSE Listed 1010, ANSI A112.26.1, PDI Listed WH-201. The device shall be pre-charged and sealed at the factory.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Pressure Rating: Provide components having a pressure rating equal to or greater than the system operating pressure.
- B. Mechanically formed tee-branch outlets and brazed joints shall not be used.

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C. Aboveground Domestic Water Piping: Use the following piping materials for each size range:

1. NPS 1 and Smaller: Type L copper or PEX-a.
2. NPS 1-1/2 to NPS 3: Type L copper or CPVC.

3.2 VALVES

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use bronze ball valves for piping NPS 3 and smaller.
2. Throttling Duty: Use bronze ball or globe valves for piping NPS 3 and smaller.
3. Hot-Water-Piping, Balancing Duty.
4. Drain Duty: Hose-end drain valves.

B. Provide sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment.

C. Provide shutoff valve on each water supply to equipment and specialties. Provide shutoff valve on each water supply to plumbing fixtures without supply stops.

D. Provide shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service.

E. DHW Recirculation Balancing Valves:

1. Provide DHW recirculation balancing valves in each domestic hot water return piping branch beyond last hot water device in that branch.
2. Provide suitable line size isolation valves, unions, and strainer.
3. Provide suitable access panel as required in non-accessible ceilings and walls.

3.3 PIPING & SPECIALTIES INSTALLATION

A. Refer to Division 23 Section "Common Work Results" for installation of:

1. Basic piping requirements.
2. Joint construction requirements.
3. Hanger, support, and anchor devices.
4. Firestopping
5. Sleeves and Escutcheons
6. Wall penetration system at each service pipe penetration through foundation wall.
7. Dielectric fittings
8. Valves
9. Mechanical Identification

B. Provide aboveground domestic water piping level and plumb, free of sags, kinks, and bends.

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- C. Provide piping with no dead legs, all sections shall see water flow.
- D. Swing Connections for Expansion: Connect hot water risers and branch connections to mains with at least five pipe fittings, including tee in main.
- E. Provide air vents at piping high points. Include ball valve in inlet.
- F. Water hammer arrestors shall be installed at flush valve water closets, as shown on the plans and as recommended by Plumbing & Drainage Institute Standard PDI-WH-201. Locate units at the end of branch lines, between the last two fixtures served. Size units based on fixture unit total of branch. All branch pipes serving flush valve water closets shall have water hammer arrestors.
- G. Mixing Valves: To prevent scalding, an ASSE-1070 TMV shall be provided for hand wash sinks and lavatories. A separate TMV is not required if a code-compliant TMV is built-in to the faucet. Set at 110°F. Install as close as practical to the point of use.
 - 1.

3.4 FIELD QUALITY CONTROL

- A. Provide and test all systems per local code requirements.
- B. Perform the following steps before operation:
 - 1. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Close drain valves, hydrants, and hose bibbs.
 - 3. Open shutoff valves to fully open position.
 - 4. Open throttling valves to proper setting.
 - 5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- D. Check plumbing specialties and verify proper settings, adjustments, and operation.
- E. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - 2. 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:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

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- b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- F. Test domestic water piping as follows:
- 1. 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 separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.
- G. Test plumbing specialties according to authorities having jurisdiction and the device's reference standard. Domestic water piping specialties will be considered defective if they do not pass tests and inspections. Prepare test and inspection reports.
- H. Adjust each backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.5 CLEANING

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses. Clean and disinfect domestic water piping per code requirements or administrative authority requirements. Sample procedure as indicated:
- 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following: 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. Fill system or part thereof with

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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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 221116

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SECTION 221316 – PLUMBING SANITARY AND STORM PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section: “Common Work Results”

1.2 SUMMARY

- A. This Section includes piping and specialties.
 - 1. Drainage and vent piping.
 - 2. Storm-drainage piping.
 - 3. HVAC condensate waste piping.
- B. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- C. General layout shown, provide piping to fixtures as required by the local plumbing code. A licensed master plumber shall perform or supervise the work and provide layouts, piping, and fittings as required by code.

1.3 PERFORMANCE REQUIREMENTS

- A. Comply with the utility requirements for the connection of to the municipal utility services. Obtain and pay for all necessary permits from the applicable municipal department. Obtain authority to connect to their existing mains.
- B. Provide components and installation capable of producing piping systems with working-pressure ratings per local plumbing code.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections.

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- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with the local building and plumbing codes.

PART 2 - PRODUCTS

2.1 CAST-IRON SOIL PIPING

- A. Hubless
 - 1. Hubless Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A-888 and CISPI Standard 301. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
 - 2. Hubless couplings shall conform to ASTM C-1540 heavy duty couplings.
 - 3. Gaskets shall conform to ASTM C-564. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and local code requirements.
 - 4. Couplings shall be installed in accordance with the manufacturer's band tightening sequence and torque. Tighten bands with a properly calibrated torque limiting device.
- B. Hub and Spigot Cast Iron Soil Pipe and Fittings:
 - 1. Hub and Spigot Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A-74. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. Pipe and fittings to be Extra Heavy (XH).
 - 2. Joints can be made using a compression gasket manufactured from a neoprene elastomer meeting the requirements of ASTM C-1563 or lead and oakum. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and local code requirements. The system shall be hydrostatically tested after installation to 10 ft. of head (4.3 psi maximum).

2.2 PVC DRAINAGE PIPING

- A. Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D-1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM D-1785 and ASTM D-2665. Fittings shall conform to ASTM D-2665.
- B. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. Solvent cements shall

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conform to ASTM D-2564, primer shall conform to ASTM F-656. The system to be manufactured by Charlotte Pipe and Foundry Co. or approved equal; and shall be intended for non-pressure drainage applications where the temperature will not exceed 140°F.

- C. Solvent cement joints for PVC pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square and pipe shall be deburred. Where surfaces to be joined are cleaned and free of dirt, moisture, oil and other foreign material, apply primer in accordance with ASTM F656.

2.3 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, 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 B 88, Type L and Type M, water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
- E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 AUTOMATIC CONDENSATE PUMP UNITS

- A. Manufacturers:
 - 1. Bell & Gossett
 - 2. Little Giant
 - 3. Hartell Div.; Milton Roy Co.
 - 4. Marsh Manufacturing, Inc.
 - 5. Blue Diamond
- B. The pumps shall be of the high efficiency type specifically designed for quiet operation.
 - 1. Pump Housing: ABS Material
 - 2. O-Ring: EPDM
 - 3. Bearing: Carbon/Alumina Ceramic
 - 4. Impeller: Nylon/PPO
 - 5. Motor: High Efficiency ECM
 - 6. All Other Wetted Parts: Type 316 Stainless Steel
 - 7. Shaft-less, seal-less construction
 - 8. Pump to be suitable for 140°F operation.
 - 9. Green LED to indicate when pump is operating
 - 10. Tank Volume: 0.184 gallons total (0.132 gallons usable)
 - 11. Main cable (6.5ft) with shock-proof plug
- C. Motor shall be non-overloading at any point on the pump curve and shall have built in overload protection.

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D. Provide condensate removal pumps come as a kit ready for installation. Kits shall include:

1. Condensate Pump
2. Mounting bracket (designed for rear wall or left side wall mounting)
3. Pressure hose connection kit
4. Pressure hose: 19 feet length.
5. Non-return valve.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Pipe fittings assembled to make a trapped receptacle similar to a floor drain but usually without a grate. They are installed with the top above the floor level, so they are not a substitute for a floor drain.
2. Shop or field fabricate from ASTM A 74, 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 C 564, rubber gaskets.
3. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: P-traps that are made with a deeper-than-normal water seal.
2. Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
3. Size: Same as connected waste piping. NPS 2: 4-inch-minimum water seal. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Stack Flashing Fittings:

1. Description: devices for flashing around vent piping at roof penetrations.
2. Counter flashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
3. Size: Same as connected stack vent or vent stack.

D. Expansion Joints: telescoping pipe fittings that permit the contraction or expansion movement of vertical stacks. Standard: ASME A112.21.2M. Body: Cast iron with bronze sleeve, packing, and gland.

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. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
3. Small AC condensate drain into sink trap: Airgap International, Inc. Drain Boa, Eco-Tech, or equal; Inlet port directly accepts 3/8" poly tubing. Dual plumbing code listed sink tailpiece fitting. Listed by NSF® and UPC®.

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4. Fixed Air-Gap Fittings: Zurn Z1024/Z1025 or Precision Plumbing Products; manufactured cast-iron or bronze drainage fitting with semi-open top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.

2.6 CLEANOUTS

A. Manufacturers

1. Zurn
2. Smith, Jay R. Mfg. Co.
3. Josam Co.
4. Tyler Pipe, Wade Div.
5. Watts Industries, Inc., Drainage Products Div.
6. Mifab
7. Wade

B. Provide per plumbing code.

C. Cleanouts shall be easily accessible and shall be gastight and watertight. Provide a minimum clearance of 24 inches for the rodding. Size of cleanout shall be same as pipe size through 4”.

D. Basis of Design Watts CO-200-R

1. Compliance: ANSI/ASME A112.36.2M.
2. Load Rating: MD - Safe Live Load 2,000-4,999 lbs.
3. Epoxy coated cast iron floor cleanout with 5" round adjustable gasketed nickel bronze top, removable gas tight gasketed brass cleanout plug, and no hub (standard) outlet.
4. When a waterproof membrane is used in the floor system, provide clamping collars on the cleanouts.
5. In carpeted areas, provide carpet cleanout markers.
6. Round, square, or recessed for tile tops as required.

E. Cleanouts shall consist of "Y" fittings and (1/8 inch) bends with brass or bronze screw plugs.

F. Provide cleanouts at or near the base of the vertical stacks with the cleanout plug located approximately 24 inches above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack Cleanout shall consist of sanitary tees. . Extend the cleanouts to the wall access cover; Zurn 1400 Series.

G. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

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2.7 FLOOR DRAINS

A. Manufacturers

1. Zurn Industries, Inc
2. Jay R. Smith Mfg. Co.
3. Tyler Pipe, Wade Div.
4. Watts Industries, Inc
5. Mifab
6. Wade

- B. Floor drains shall comply with ASME A112.21.1M. Provide outlet type as required by piping system used.
- C. Provide ½” trap primer connection as indicated on plans.
- D. Light Duty FD-1 finished areas; Epoxy coated cast iron floor drain with anchor flange, reversible clamping collar with primary and secondary weepholes, post-pour adjustable round heel proof nickel bronze strainer with integrated bubble level, leveling shims, and no hub (standard) outlet.
1. Provide vandal secured top as scheduled.
 2. Round: Watts FD-190-PR5
 3. Square: Watts FD-100-M5 provide for tile floors.
- E. Shower drains: see plumbing fixture specification.

2.8 TRAP SEAL PRIMER VALVES

A. Manufacturers:

1. Precision Plumbing Products, Inc.
2. Josam Co.
3. Watts.
4. Zurn
5. Mifab
6. Sioux Chief

- B. Trap primer make up lines shall have a continuous slope to the floor drain.
- C. Automatic Trap Seal Primer – TP-1:
1. MIFAB M-500 Series; pressure activated trap seal primers (MR-500-NPB, M1-500-NPB and M2-500-) can be connected to any cold-water line and shall be automatically activated when a valve or faucet, that is on the line, is opened.
 2. A pressure drop of three (3) PSI shall activate the trap seal primer. A 5 PSI activation level is not acceptable

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3. Trap seal primers can be disassembled in the field. The design shall permit filter replacement without affecting the performance of the primer. The “O” ring seals shall be tested for reliability at a temperature range of -40 degrees to 450 degrees F.
4. The trap seal primer shall not require adjustment.
5. Standard: ASSE 1018; lead free.
6. Provide a ball valve upstream of the trap primer.
7. Provide an “MI-GAP” air gap fitting with ½” male inlet and ½” female outlet; built-in 1” air gap.

D. Electronic Trap Primer – TP-2:

1. Precision Plumbing Products Model MP-500
2. Operation: A preset timer energizes a normally closed electronic solenoid valve. Potable water flows across the air gap and is distributed via trap primer feed lines. The timer then de-energizes the solenoid allowing it to close until the next operational cycle.
3. Cabinet: Surface-mounted steel box; NEMA Type 1, UL 50, 12” x 12” x 4” - 16-gauge steel w/screw on cover ANSI 61 gray polyester powder paint.
4. Electric Controls: Pre-set timer opens once for 6 seconds every 24hours. 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. 120/1/60, 0.23 Amps. Circuit Breaker, Test Switch, Timer, Solenoid Valve UL Listed. Electrical assembly listed per UL # 73.
5. Air gap fitting
6. Solenoid valve with integral strainer screen
7. Piping: ASTM B 88, Type L copper water tubing. 95-5 lead-free. Containing lead not in the excess of 0.2%; Inlet: ½” NPT male; Outlet: ½” NPT female.
8. Provide a distribution unit for multiple outlet installations.
9. Standard: ASSE 1044.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Aboveground and Underground, Soil, Storm, Waste, and Vent Piping: Use PVC or cast iron.
- C. HVAC Unit Condensate Indirect Waste: Drain Lines: PVC or DWV Copper Tubing: ASTM B 306, Type DWV.

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3.2 PIPING INSTALLATION

- A. Refer to Division 23 Section "Common Work Results" for installation of:
1. Basic piping requirements.
 2. Joint construction requirements.
 3. Hanger, support, and anchor devices.
 4. Firestopping
 5. Sleeves and Escutcheons
 6. Wall penetration system at each service pipe penetration through foundation wall.
 7. Dielectric fittings
 8. Valves
 9. Mechanical Identification
- B. Provide cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Make joints according to CISPI.
 2. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 3. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. Provide PVC soil and waste drainage and vent piping according to ASTM D 2665.
- D. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- E. Provide drainage piping beginning at low point of each system. Provide true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Provide required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- F. Provide drainage and vent piping at the minimum slopes as required by the local plumbing code.
- G. Connect HVAC drain pans per manufacturer's instructions.
1. Piping shall be provided with a 1/8" foot minimum slope.
 2. Height of unit must be carefully coordinated to provide for proper condensate drainage.
 3. Provide each 90-degree change in direction with a Y-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.
 4. Piping shall be equal to or larger than the drain pan connection size.

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5. If required by manufacturer for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with manufacturer's requirements.
6. Route indoor unit condensate drains to sink traps, floor drains, plumbing code compliant, or other locations as indicated.

3.3 AUTOMATIC CONDENSATE PUMP UNITS

- A. Provide units for collecting condensate and extend to open drain, floor drain, mop sink, or other approved location.
- B. Mount pump level, secured to wall.
 1. Condensate supply hose must be routed with a downward slope to the pump.
 2. Secure the hose using hose clamps.
 3. After securing hose on the non-return valve, lock non- return valve by rotating valve one quarter turn clockwise.
- C. After installing the condensate pump, test it to ensure that it functions correctly. To test the function, pour water into the tank until the activation level is reached and the pump starts. If air in the pump causes the integrated dry-run protection to actuate (pump deactivates, green and red operating lamp flash), add additional water and re-test.
- D. Shutoff Valves: Provide full-port ball valve on each pump discharge.
- E. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect drainage and vent piping to fixtures and equipment as shown on the plans.
- C. Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
- D. Provide traps on plumbing specialty drain outlets.
- E. Cleanouts:
 1. Provide cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated: Size same as drainage piping up to NPS 4. Locate at each change in direction of piping greater than 45 degrees. Locate at minimum intervals of 50 feet. Locate at base of each vertical soil and waste stack.
 2. Provide cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.

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3. Provide cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
 4. Provide flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- F. Provide floor drains in accordance with manufacturer's instructions at locations indicated on the drawings.
1. Protect installed floor drains from damage during construction.
 2. Provide floor drains at low points of surface areas to be drained. Floor s shall be sloped to floor drains.
 3. Provide floor drains plumb, level, and to correct elevation.
 4. Ensure top of floor drains are flush with top of finished floor.
 5. Provide floor drains using manufacturer's supplied hardware.
 6. Coordinate depressed/pitched slab with concrete contractor.
 7. Provide floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 8. Provide individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Trap primers:
1. Provide floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection. Primers shall be accessible for maintenance.
 2. Provide trap seal primers in accordance with manufacturer's instructions.
 3. Cycle trap seal primers a minimum of 6 times to ensure optimum performance.
 4. Ensure flux and other debris is removed.
 5. Do not install trap seal primers closer than 40 feet apart when using same potable water supply line.
 6. Mount trap seal primers in a vertical position 1 foot above finished floor for every 20 feet of floor drain trap make-up water line.
 7. Provide union connection above trap seal primers.
 8. Provide line shut-off valve upstream of trap seal primers to shut off water supply when performing maintenance on trap seal primers.
 9. Avoid direct installation to prevent foreign material from entering directly into trap seal primers.

3.5 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.

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- B. Test piping according to 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. 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 drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. 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. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch w.g. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. 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.
- C. Test force-main piping according to 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. 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. Isolate test source and allow to stand for four hours. 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.
- D. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- E. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

3.6 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

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- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

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SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results"
 - 2. Division 22 Plumbing Sections

1.2 SUMMARY

- A. This Section includes Plumbing Fixtures.

1.3 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
- B. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Comply with the local building and plumbing codes.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

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- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.
- F. Coordinate roughing-in and final plumbing fixture locations and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 GENERAL

A. Common Plumbing Fixture Requirements

1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixture color shall be white except as specified herein.
2. Provide combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
3. Fixtures shall be provided appurtenances such as traps, supplies, faucets, stop valves, and drain fittings – for a complete, finished, code-compliant installation.
4. Coordinate fixture rough in dimensions for conflicts with surrounding structure, prior to submitting.
5. Each fixture and piece of equipment requiring connections to the drainage system shall be equipped with a trap.
6. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view.
7. Fixture supports for off-the-floor fixtures shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab. Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.
8. Provide access panels to concealed valves and components. All components shall have proper access in accordance with manufactures' recommendations.
9. Mounting heights: Refer to Architectural Plans.
10. Water line components shall be lead-free.

2.2 FLUSH VALVE WATER CLOSETS

A. Manufacturers:

1. American Standard
2. Kohler

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3. Toto
4. Sloan

B. Water Closets - Common Requirements:

1. Comply with ASME A112.19.2 – Ceramic Plumbing Fixtures; Comply with ADA
2. Material: Vitreous china.
3. Type: Siphon jet.
4. Style: Flushometer valve.
5. Rim Contour: Elongated.
6. Support: Water-closet carrier
7. Water Consumption: 1.28 GPF.
8. Spud Size and Location: NPS 1-1/2; top.
9. Toilet Seats: Standard: IAPMO/ANSI Z124.5; solid polypropylene with special surface that inhibits the growth of stain and odor causing bacteria, mold and mildew on the surface; commercial heavy duty; Shape: Elongated rim, open front; Seat Cover: Not required. Color: White.

- C. P-1:** Wall mounted, top spud. American Standard AFWall; Water Closet Carrier: Standard: ASME A112.6.1M. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement; with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Mounting Height: See Architectural plan.



1. Flushometer: Lever-Handle, Exposed, Piston Flushometer Valves: Sloan Crowne
 - a. Comply with ASSE 1037 and ASME A112.19.5, and ADA. Include integral check stop and backflow-prevention device.
 - b. Material: Brass body with corrosion-resistant components. Flushometer Finish: Chrome plated.

2.3 VITREOUS-CHINA LAVATORIES

A. Lavatory Manufacturers:

1. Zurn
2. American Standard
3. Kohler
4. Toto
5. Duravit

B. Lavatories – Common Requirements:

1. Standard: ASME A112.19.2/CSA B45.1; ADA.
2. Faucet-Hole Punching: Match faucet, coordinate hole locations.

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3. Provide a permanent surface that inhibits the growth of stain and odor causing bacteria, mold and mildew on the surface
4. Provide overflow.
5. Provide 304 stainless steel grid drain unless noted otherwise.
6. Risers: Supply line: supplied by fixture manufacturer, or by McGuire or Brasscraft. Shall be lead-free, loose key standard stop lavatory supply kit, two polished chrome, solid brass angle stops with wheel handles, two 12" flexible chrome-plated lavatory risers complete with two forged brass with set screw flanges; connections: 1/2" sweat x 3/8" OD.
7. Waste Fittings: Standard: ASME A112.18.2
8. Drain: Stainless steel grid type with NPS 1-1/4 offset and straight tailpiece.
9. Trap: NPS 1-1/2 by NPS 1-1/4; Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated, brass or steel wall flange.
10. Provide ADA trim kits for exposed piping.
 - a. Pipe covering kit equal to Dearborn Safety Series by Oatey; Cover opens 180° for easy installation, EVA foam material, sized for 1 1/4" and 1 1/2" cast traps, IAPMOPS-94.
11. Faucets: See LAVATORY & SINK FAUCETS paragraph below.

C. P-3: Drop-in Counter-Mounted, self-rimming. Provide mounting sealant and cutout template.

1. American Standard Aqualyn Model 0476. Bowl Size: 16"W, 10" front to back, 5-5/8"D. Overall size: 20-38" x 17-3/8".



D. Lavatory Faucets:

1. See faucet specifications in paragraphs hereinafter.
2. Wrist blade
3. ADA lever handles
4. Sensor – battery
5. Sensor – hard wired.

2.4 LAVATORY & SINK FAUCETS

A. Faucet Manufacturers

1. Moen
2. Symmons
3. Delta Commercial
4. Chicago
5. Gerber

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6. Zurn
7. Kohler
8. American Standard

B. Faucets - Common Requirements:

1. Comply with ASME A112.18.1M, NSF372-2011, ADA; UL 1951
2. Body Material: Commercial, solid cast brass.
3. Lead Free: Faucet contains $\leq 0.25\%$ total lead content by weighted average
4. Thermostatic mixing valves (TMV), as indicated: 20" flexible stainless steel inlet hoses with 3/8" compression fittings. ASSE 1070 certified down to 0.35 GPM
5. Provide antimicrobial handles: Chicago Sureshield® Technology, or equal; In a 28-day dried film fungal test (ASTM G 21-96), the untreated sample shows significant fungal growth, while the Sureshield sample remains virtually unchanged.

C. Manual Type:

1. **P-3:** ADA lever handle: American Standard Colony Pro Centerset Single Handle Bathroom Faucet; 4" centerset; ceramic disc valve; hot limit safety stop.
2. Provide ASSE-1070 thermostatic mixing valve.

2.5 SHOWERS

A. Shower Manufacturers

- a. Clarion Bathware
- b. Aqua Bath Co., Inc.
- c. Aquarius.
- d. Aquatic
- e. Fiat Products
- f. LASCOS Bathware

B. Faucet Manufacturers

1. Symmons
2. Moen
3. Powers
4. Leonard
5. Grohe

C. P-2 Standard Shower (Double Threshold)

1. Basis of Design: Fiat MFTD – Monterey Double Threshold shower base; 32" x 32" x 4" outside dimensions.
2. Precast terrazzo one piece products are made of black and white marble chips cast in white portland cement to produce a compressive strength of not less than 3000 P.S.I., seven days after casting.
3. Offset drain location; The stainless-steel drain body is cast integrally into the shower floor and sized for a gasket connection.
 - a. Provide Quick Connect gasket.

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- b. Drain location shall be 6.5" from front edge, and 6.5" from wall edge. Coordinate with drawings and architect.
4. The terrazzo surface is ground and polished with all air holes and/or pits grouted and the excess removed.
5. Tiling flange, cast integral, is of stainless steel and shall extend not less than 1" above the shoulder and not less than 1-1/4" wide.
6. Removable type stainless steel strainer plate.
7. UPC listed.

D. P-4 Transfer Shower (ADA Accessible)

1. Basis of Design: Clarion Model SP3838BF34; 38" x 38" x 4.5" outside dimensions. Inside dimensions: 36" x 36".
2. Color: White.
3. Code compliant when fully equipped and installed according to guidelines; Barrier-free design, meets ADA 2010 standards and requirements.
 - a. Certified to meet CSA B45.5/IAPMO Z124 Standard.
 - b. When properly accessorized and installed, product will meet requirements of ADA (2010 Std), ICC/ANSI A 117.1-2009, ABA or UFAS.
4. Center drain location; provide a brass chrome plated drain.
5. Slip resistant, textured bottom; ASTM F-462.
6. Material: AcrylX
7. Water migration channel.
8. Floor nailing flange.
9. 0.75" threshold.
10. Provide drain body and strainer.

E. P-5 Transfer Shower (ADA Accessible)

1. Basis of Design: Aquarius MPB 5436 BF 1.0 - WHT, the unit shall have dimensions of 54" x 37" x 4.25".
2. Shape: Rectangular
3. Finished surface shall be AcrylX solid-surface with gelcoat finish.
4. Code compliant with IPC, UPC, and ANSI Z 124.2.
5. Barrier free threshold. Change of level threshold has a manageable 0.25" vertical rise to easily coordinate with minimum finished flooring.
6. Self-supporting and pre-levelled shower base is standard.
7. Thirty-year limited warranty.
8. The unit shall meet ADA, ICC-ANSI A117.1, Ansi Z124.1.2, and CSA B45.5.
9. Color: White
10. Provide drain body and strainer.

F. Shower Faucet

1. Symmons Model BP-56-300-B30-V Temptrol II™ Shower System with Hand Spray
2. Pressure-balancing mixing valve with adjustable stop screw to limit handle turn.
3. ADA compliant.
4. Wall/hand shower with 5' flexible metal hose, in-line vacuum breaker, wall connection and flange. 30" slide bar for hand shower mounting.
5. Provide modifications:

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- a. Suffix X: Integral service stops—allows water shut-off at valve for service
- b. Suffix 1.5: 1.5 GPM flow rate

- G. Floor Drain: Zurn Z415SH-18 floor and shower drain, Dura-Coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with seepage slots and "TYPE SH" polished nickel bronze, 6"X6" square hinged, light-duty strainer, leveling ring.

2.6 ELECTRIC WATER COOLERS

A. Manufacturers

- 1. Halsey Taylor.
- 2. Elkay Manufacturing Co.
- 3. Haws Corporation.
- 4. Oasis Corporation.
- 5. Sunroc Corp.

B. General

- 1. Adjust fixture flow regulators for proper flow and stream height. Adjust water-cooler temperature settings.
- 2. Waterways shall be 100% lead-free.
- 3. Laminar flow shall produce an even flow and eliminate splashing
- 4. Barrier free for full ADA access

- C. **P-6** Electric Water Cooler (Mechanically Cooled, Wall Hung, Wheelchair, with Glass Filler) bubbler style, air cooled compressor, 15 gph minimum capacity. Top shall be one piece type 304 CRS anti-splash design. Cabinet, CRS satin finish, approximately 18 inches by 18 inches by 25 inches high with mounting plate. Unit shall be push bar operated with front and side bars, automatic stream regulator, and heavy chrome plated brass push down glass filler with adjustable flow control, and all trim chrome plated. Set bubbler 36 inches above finished floor. Provide with bottle filler option.

2.7 MOP SERVICE BASIN - P-7

A. Manufacturers:

- 1. Zurn
- 2. Fiat
- 3. Mustee
- 4. Fiat

B. Provide check valves at HW and CW connections.

- C. 24 x 24 x 10" H Mop Service Basin: Zurn Z1996-24. Molded high density molded stone basin; PVC drain body, stainless steel strainer, and 3" gasketed outlet connection. Certifications: Meets ANSI Z124.6, CSA listed, and IAPMO listed under file # 3561.

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1. Wall Guard (-WG) Provide 20 gage type 304 stainless steel bumpers used to protect walls adjacent to mop basin. Two panels shall be supplied for corner installation
 2. Mop holder (-MH): Stainless steel 24" long x 3" wide with three rubber tool grips
 3. Bumper Guards (-BS) Provide 20 gage type 304 stainless steel bumper guards to protect top edge of basin.
- D. Chicago Faucets No. 540-LD897SWXFABCP, wall mounted. 8" fixed centers, Hot and cold water sink faucet, chrome plated solid brass construction. 5 3/4" center to center rigid vacuum breaker spout with 3/4" male hose thread and pail hook. 2 3/8" metal lever handles with eight point tapered broach and secured blue and red buttons. Quarter-turn re-buildable compression cartridge, opens and closes 90°, closes with water pressure, features square tapered stem. Straight 2" inlet supply arm with wall flange with 1/2" NPT female thread inlet. Provide atmospheric vacuum breaker. ECAST® construction with less than 0.25% lead content by weighted average. Provide per ADA ANSI/ICC A117.1 requirements and shall be tested and certified to industry standards: ASME A112.18.1/CSA B125.1, California Health and Safety Code 116875 (AB1953-2006), Vermont Bill S.152, and NSF/ANSI 372 Low Lead Content.

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 fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION - GENERAL

- A. Assemble and support fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Provide fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- C. Provide water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Provide stops in locations where they can be easily reached for operation.
- D. Provide traps on fixture outlets as required.
- E. Provide level and plumb according to roughing-in drawings.
- F. Provide supports and connections to fixtures per manufacturer's instructions.

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- G. Provide escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.
- H. Set floor mounted fixtures in a leveling bed of cement grout as per fixture manufacturer's instructions.
- I. Joint Sealing: Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Division 9.
- J. Wall Flange and Escutcheon Installation: Provide wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork. Provide deep-pattern escutcheons if required to conceal protruding fittings.

3.3 WATER CLOSET INSTALLATION

- A. Provide flush handle mounted on open (approach) side of fixture. Provide actuators in locations that are easy for people with disabilities to reach.
- B. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
- C. Provide toilet seats on water closets.

3.4 SINKS AND LAVATORIES

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls. Adjust water pressure at faucets to produce proper flow.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.
- C. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

3.6 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed. Check that fixtures are complete with trim, faucets, fittings, and other specified components. Inspect installed fixtures for damage. Replace damaged fixtures and components.

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- B. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves. Adjust set point within allowable temperature range.
- D. Operate and adjust fixtures. Replace damaged and malfunctioning fixtures, fittings, and controls.
- E. Adjust water pressure to produce proper flow and stream.
- F. Replace washers and seals of leaking and dripping faucets and stops.

3.7 CLEANING

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures and other fittings with manufacturers' recommended cleaning methods and materials. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts. Remove sediment and debris from drains.
- C. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

3.8 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless allowed in Division 1.

END OF SECTION 224000

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SECTION 230500 – COMMON WORK RESULTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. This section applies to Plumbing Division 22 & and HVAC Division 23 sections.

1.2 GENERAL

- A. Section 230500 includes items common to all the division specification sections.
- B. Provide services, skilled and common labor, and all apparatus and materials required for the complete installation as shown and within the intent of the contract documents, field conditions, and code requirements.
- C. The intention of these Contract Documents is to call for finished work, fully tested and ready for operation. Any components or labor not mentioned in the Contract Documents but required for functioning systems shall be provided. Should there appear to be any discrepancies or questions of intent, the Contractor shall refer the matter to the Architect/Engineer for a decision before start of any related work.
- D. Consistency and Completeness: The contract documents are intended to include all components; however, the contract documents may not be perfect. Repetitive, common components (such as volume dampers, thermostats, condensate drains, trap primers, vent pipes, valves, etc.) are shown throughout. If a common component is missing in from the drawings, provide as similar per other areas. There will be no change orders for missing such components, the contractor shall provide consistent, complete, functioning systems.
- E. Should the Drawings or the Specifications disagree in themselves or with each other, the Contractor shall provide the better quality or greater quantity of work and/or materials unless otherwise directed by written addendum to the Contract Documents.
- F. Materials or work described in words, which so applied, have a well-known technical or trade meaning shall be held to refer to such recognized standards. Since the plans and specifications cover the dimensions and features of the work and do not set forth the analysis of the design, it is the duty of the Contractor fulfilling them to ascertain the true intent in any case where it is doubtful.

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1.3 MANUFACTURERS INSTRUCTIONS

- A. Provide equipment and components to comply with manufacturer's written installation instructions and published drawings.
- B. Follow manufacturer's instructions for inspection, start-up, calibration, commissioning, and testing.

1.4 EFFICIENCY MAINE

- A. This project intends to pursue Efficient Maine prescriptive and/or custom incentives. The contractor shall participate in the activities associated with Efficiency Maine incentive approval process including but not limited to; preparation and submission of required incentive applications and the tracking and submission of measure specific invoices to Efficiency Maine within 60 days of the completion of the work.
- B. The contractor shall become familiar with the Efficiency Maine Business Program including available incentives and the application and review process. Efficiency Maine is available to assist in the application process and can be reached at <https://www.energysave.com/at-work/>. Contractor must contact EM prior to submittals to review the project equipment and scope.
 - 1. <https://www.energysave.com/at-work/ci-incentive-program/>
 - 2. Review plans and specifications for compliance with Efficiency Maine standards for applicable systems and technologies.
 - 3. Review plans and specifications for incentive opportunities.
- C. The project schedule shall reflect and accommodate the time required to achieve application pre-approval from Efficiency Maine (EM). No equipment shall be purchased until pre-approval is received from EM.
- D. Invoices shall be forwarded to EM within 60 days of the completion of the work. This deliverable shall be shown on the project schedule as a milestone date and coordinated with all contractors to assure compliance with this requirement.
- E. As a minimum, obtain rebates for the following:
 - 1. VRF Heat Pumps
 - 2. DOAS Units

1.5 DEFINITIONS

- A. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- B. "Provide": Furnish and install, complete and ready for the intended use.

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- C. “Shall”: The word “shall” is used to indicate mandatory requirements strictly to be followed in order to conform to the standard and procedures and from which no deviation is permitted.
- D. 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, crawlspace, and attics.
- E. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- F. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- G. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- H. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- I. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

1.6 SUBMITTALS

- A. Provide in accordance with Division 1 of the specifications.

1.7 SUBSTITUTIONS

- A. Provide in accordance with Division 1 of the specifications.
- B. Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
 - 1. 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 Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - 2. Requested substitution does not require revisions to the Contract Documents.
 - 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - 4. Substitution request is fully documented and properly submitted.
 - 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 - 6. Requested substitution has received necessary approvals of authorities having jurisdiction.

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7. Requested substitution is compatible with other portions of the Work and shall be acceptable to all contractors involved.
8. Equipment electrical characteristics different than scheduled may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no additional cost.
9. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
10. Requested substitution has been coordinated with other portions of the Work.
11. Requested substitution provides specified warranty.

1.8 QUALITY ASSURANCE

- A. Work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications.
- B. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- C. Installer Qualifications: Work shall be done by skilled mechanics shall have successfully completed an apprenticeship program or another craft training program.
- D. The Contractor shall hold a license to perform the work as issued by the local jurisdiction.

1.9 COORDINATION

- A. Coordinate use of project space and sequence of installation of work, which is indicated diagrammatically on drawings. Follow routings shown, as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- B. Coordinate use of project space and sequence of installation of work.
- C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for installations. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Coordinate requirements for access panels and doors for items requiring access that are concealed behind finished surfaces. Access panels shall be provided for any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.
 1. Access panels and doors are specified and provided by Division 8.

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1.10 TEST ADJUST AND BALANCE READINESS

- A. The Contractor shall provide and coordinate the services of qualified, responsible sub-contractors, suppliers and personnel as required to correct, repair, and/or replace deficient items or conditions found during the course of this project, including the testing, adjusting, and balancing period.
- B. In order that systems may be properly tested, balanced, and adjusted as required herein by these Specifications, the Contractor shall operate the systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. The Contractor shall allow adequate time for the testing and balancing activities of the Owner provided services, during the construction period, and prior to Substantial Completion as defined in the Uniform General Conditions of this Construction Document.
- C. The Drawings and Specifications indicate adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to provide these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB Firm. Also, any malfunction encountered by TAB personnel and reported to the Contractor shall be corrected by the Contractor immediately so that the balancing work can proceed with the minimum of delays.
- D. Complete operational readiness of the HVAC systems also requires that the following be accomplished:
 - 1. Distribution Systems:
 - a. Verify installation for conformity to design. Ducts shall be terminated and tested as required by the Specification.
 - b. Dampers shall be properly located and functional. Dampers shall have tight closure and open fully with smooth and free operation.
 - c. RGD'S and terminal devices shall be provided and secured in a fully open position.
 - d. Air handling systems and associated apparatus shall be sealed to eliminate uncontrolled bypass or leakage of air. Clean filters shall be in place, coils shall be clean with fins straightened, bearings properly greased, and the system shall be completely operational. The Contractor shall verify that systems are operating within the design pressure limits of the piping and ductwork.
 - e. Under normal operating conditions, check condensate drains for proper connections and functioning. Cooling coil drain pans have a positive slope to drain. Cooling coil condensate drain trap maintains an air seal.
 - f. Fans shall be operating and verified for freedom from vibration, proper fan rotation.
 - g. Bearings shall be greased.

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2. Water Circulating Systems:

- a. Verify installation for conformity to design. Hydronic systems are pressure tested, flushed, filled, and properly vented; valves are fully open. Examine HVAC system and equipment installations to verify that indicated balancing devices are properly provided, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation
- b. Valves shall be set to their fully open position. After the system is flushed and checked for proper operation, strainers shall be removed and cleaned. The Contractor shall repeat the operation until circulating water is clean and then the start-up strainers shall be discarded.
- c. Record motor amperage on each phase and voltage after reaching rated speed. Readings shall not exceed nameplate rating. Thermal overload protection is in place.
- d. In preparation of TAB, water circulating systems shall be full and free of air, expansion tanks shall be set for proper water level, and air vents shall be provided at high points of systems and operating freely. Chemicals shall be added to closed systems to treat piping and inhibit corrosion. The system static pressure shall be adequate to completely fill the system without operating the pumps.
- e. Check and set operating parameters of the heat transfer and control devices to the design requirements.
- f. Proper balancing devices shall be in place and located correctly. Heat transfer coils shall be checked for correct piping connections.

3. Building Automation System (BAS)

- a. The BAS Contractor shall verify that control components are provided in accordance with project requirements and are functional.
- b. The BAS Contractor shall verify that controlling instruments are calibrated and set for design operating conditions with the exception of components that require input from the TAB Agency, but a default shall be set. The Control Contractor shall cooperate with the TAB Agency and provide software and interfaces to communicate with the system.
- c. The BAS Contractor shall thoroughly check controls, sensors, operators, sequences, etc. before notifying the TAB Agency that the BAS is operational. The BAS Contractor shall provide technical support (technicians and necessary computers) to the TAB Agency for a complete check of these systems.
- d. Prior to occupancy, each ventilation system shall be tested to ensure that OA dampers operate properly in accordance with system design.
- e. Fire Alarm: Division 26 shall thoroughly check detection devices, sequences, inter-locks, etc. before notifying the TAB Agency that the system is operational. Division 26 shall certify that the systems are totally operational to the Contractor prior to the TAB beginning.

1.11 RENOVATION PROJECT REQUIREMENTS

- A. The Contractor shall cooperate with the Owner to minimize conflicts with the Owner's operations.

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- B. The Contractor shall study drawings and specifications, visit the site, and get acquainted with the existing conditions and the requirements of the plans and specifications. No claim will be recognized for extra compensation due to the failure of the Contractor to be familiarized with the conditions and extent of the proposed work. The Contractor shall execute alterations, additions, removals, relocations, or new work, etc., as indicated, or required to provide a complete installation in accordance with the intent of the drawing and specifications.
- C. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated. Keep driveways and entrances serving premises clear and available to Owner. Schedule deliveries to minimize use of driveways and entrances and minimize space and time requirements for storage of materials and equipment on-site.
- D. Follow the recommended procedures of the SMACNA IAQ Guidelines for Occupied Buildings under Construction.
- E. Continuity of Services: The building will be in use during construction operations. Maintain existing systems in operation within rooms of building. Schedules for various phases of contract work shall be coordinated with other trades and with Owner's Representative. Provide, as part of the contract, temporary plumbing and mechanical and electrical connections and relocations as required to accomplish the above. 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. Notify Owner at least two days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions. Indicate method of providing temporary utilities. Do not proceed with utility interruptions without Owner's written permission.
- F. Cutting And Patching: Provide temporary support of Work to be cut. 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. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
 - 1. Where existing services/systems are required to be removed relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
 - 2. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay. 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.
 - 3. 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.
 - 4. 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 possible. Provide materials and comply with installation requirements specified in other Sections. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and

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- refinishing. Clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
5. Any structural member weakened or impaired by cutting, notching, or otherwise shall be reinforced, repaired, or replaced so as to be left in safe structural condition in accordance with the local building code requirements.
 6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
 7. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

PART 2 - PRODUCT

2.1 PRODUCT CRITERIA

- A. Any costs incurred due to deviations from basis of design unit shall be responsibility of the contractor.
- B. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 5 years.
- C. Equipment Service: Products shall be supported by a service organization that maintains a complete inventory of repair parts and is located reasonably close to the site.
- D. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- E. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
- F. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- G. Asbestos products or equipment or materials containing asbestos shall not be used.

2.2 PROGRAMMABLE 3-PHASE LINE VOLTAGE MONITORS

- A. Provide for all inverter-driven equipment.
- B. Provide an ICM Controls Model #ICM450A or equal, for motor protection from premature failure and damage caused by common voltage faults such as phase unbalance, over/under voltage, phase loss and phase reversal.
 1. Voltage: Universal, 190-600 VAC
 2. Simultaneous 3-phase true RMS voltage monitoring
 3. Factory calibrated.

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4. 3-phase voltages simultaneously displayed on LCD
5. Fault memory
6. Fault monitoring: High / low voltage, voltage unbalance, phase loss, phase reversal
7. Simple configuration
8. Fully adjustable variables
9. Modbus RS485 communications
10. LED indicators
11. Common ¼" quick connect terminations.

2.3 IDENTIFICATION

A. Equipment:

1. Terminology: Match schedules as closely as possible.
2. Tag and description: Example: "EF-1 - Bathroom Exhaust"
3. Equipment Markers: Custom Vinyl Decals with a clear polyester overlamine to endure outdoor conditions and are UV and scuff resistant. Decals shall be made of flexible vinyl with a permanent pressure-sensitive adhesive backing suitable for curved surfaces. Service temperature range of -40°F to 176°F.
4. In addition to the equipment tag, equipment located above the ceiling that requires servicing shall be labeled on the ceiling grid using a labeling machine.

B. Piping Identification Devices

1. Manufactured Pipe Markers, General: Seton, Brady, or approved equal; preprinted, color-coded, with lettering indicating service, and showing direction of flow.
2. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length. Size of letters and length of color field per ASME A13.1.
3. Pipes with OD, Including Insulation; Full-band snap-around pipe markers extending 360 degrees around pipe at each location. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow. Length of color field and size of letters shall be proportional to pipe OD.
4. Types: Self-adhesive type: Seton Opti-Code; Snap-around type: Seton Setmark; Wrap-around type: Seton Ultra-mark; PVF over-laminated polyester construction seals in and protects graphics; suitable for outdoor or harsh environments.

C. Concealed manual volume dampers shall be visible outside the insulation and marked with 12" orange ribbon.

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2.4 PIPE JOINING MATERIALS

- A. Provide per local code.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Press Connections
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Viega LLC; ProPress, Apollo, or approved equal.
 - 2. Press ends shall have Viega Smart Connect, Apollo Leak Before Press, or similar technology designed into the fitting itself, allowing identification of an un-pressed fitting during pressure testing. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
 - 3. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of ASME B16.51 and IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by the fitting manufacturer.
 - 4. Steel: Cold Press Mechanical Joint Fitting shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria ANSI/CSA LC4. Sealing elements for press fittings shall be HNBR. Sealing elements shall be factory installed or an alternative supplied by the fitting manufacturer. Piping and fittings shall comply with CSA LC-4 and local codes.
- E. Mechanical Coupling Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents and exterior environment. Gasket design shall be such that the entire coupling housing is isolated from the system contents to prevent galvanic action and inhibit galvanic corrosion.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- G. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- H. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.

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- I. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- J. Solvent Cements for Joining Plastic Piping: CPVC Piping: ASTM F 493. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- K. Plastic-to-Metal Transition Fittings: one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657. Plain-End Pipe and Fittings: Use butt fusion. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Provide dielectric isolation at the connection of dissimilar metals. Provide brass ball valves or fittings; or Watts Series LF3000 (lead free) or approved equal.

2.5 SLEEVES & ESCUTCHEONS

- 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 water-stop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, 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.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated. Metals and finish shall conform to ASME A112.19.2. Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. ID shall closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers the opening. Escutcheons shall have setscrews for maintaining a fixed position against a surface.

2.6 ROOF PIPING

- A. Roof Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping. Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration. Bases: One or more; plastic. Vertical Members: Two or more cadmium-plated-steel or stainless-steel,

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continuous-thread rods. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

- B. Roof Pipe Penetrations: Thybar TCC-3 curb system with cover and pipe boots.
 - 1. Prefabricated roof curb to be manufactured of prime galvanized steel construction, 20, 18, 16 or 14 gauge as required, meeting ASTM A653/653M, with welded corners and with seams joined by continuous welds. Roof curb shall be internally reinforced with angles 48" on center, factory insulated with 1-½" thick 3# density fiberglass insulation, and factory installed wood nailers. Height to be 18" above roof deck or as detailed. Top of all roof curbs shall be level, with pitch built into curb when deck slopes.
 - 2. ABS Thermoplastic cover on top of curb.
 - 3. Graduated Boots Molded or Weather-Resistant Plastisol
 - 4. SS pipe clamps, 2 per boot.

2.7 HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-Line Systems, Inc.
 - 2. Carpenter & Patterson, Inc.
 - 3. Grinnell Corp.
 - 4. Hubbard Enterprises/Holdrite
 - 5. National Pipe Hanger Corp.
 - 6. Piping Technology & Products, Inc.
 - 7. Unistrut
 - 8. Anvil International, Inc.
 - 9. Empire
- B. Provide in accordance with MSS SP69 - Manufacturers Standardization Society: Pipe Hangers and Supports- Selection and Application. Steel pipe hangers and supports shall have the manufacturer's name, part number, and applicable size stamped on the part itself for identification.
- C. The materials of pipe hanging and supporting elements shall be in accordance with MSS SP-58. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications." Do not allow dissimilar metals to come into contact.
- D. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel." Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications." Comply with provisions in ASME B31 Series, "Code for Pressure Piping." Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

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- E. Delegated-Design Submittal: For hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Show fabrication and installation details and include calculations. Provide for the following: trapeze pipe hangers, metal framing systems, pipe stands, equipment supports.
- F. Hangers:
 - 1. Uninsulated pipes 2 inch and smaller: Adjustable steel swivel ring (band type) hanger, Type 10, B-Line B3170; Adjustable steel swivel J-hanger, Type 5, B-Line B3690; Malleable iron ring hanger, Type 12, B-Line B3198R or hinged ring hanger, B3198H. Adjustable steel clevis hanger, Type 1, B-Line B3100.
 - 2. Uninsulated pipes 2-1/2 inch and larger: Adjustable steel clevis hanger, Type 1, B-Line B3100.
 - 3. Insulated Hot piping: 2 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. Type 1, B-Line B3100 with Type 40, B-Line B3151 series insulation protection shield. 2-1/2 inch and larger pipes: Type 41 or Type 43 with Type 39A/39B, B3160-B3165 series pipe covering protection saddle.
 - 4. Insulated Cold piping: use adjustable steel clevis with galvanized sheet metal shield. Type 1, B-Line B3100 with Type 40, B-Line B3151 series insulation protection shield.
 - 5. Copper Tubing Supports Hangers shall be sized to fit copper tubing outside diameters. Adjustable steel swivel ring (band type) hanger, Type 10, B-Line B3170CT. Malleable iron ring hanger, Type 12, B-Line B3198RCT or hinged ring hanger B3198HCT. Adjustable steel clevis hanger, Type 1, B-Line B3104CT. For supporting copper tube to strut use plastic inserted vibration isolation clamps, B-Line BVT series.
 - 6. Plastic Pipe Supports: V-Bottom clevis hanger with galvanized 18-gauge continuous support channel, Type 1, B-Line B3106 and B3106V plastic pipe support channel, to form a continuous support system for plastic pipe or flexible tubing.
- G. Pipe Clamps: When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts, Type 4, B-Line B3140. For insulated lines use double bolted pipe clamps, Type 3, B-Line B3144.
- H. Multiple or Trapeze Hanger: Trapeze hangers shall be constructed from 12-gauge roll formed ASTM A1011 SS Grade 33 structural steel channel, 1-5/8 inch by 1-5/8-inch minimum, B-Line B22 strut or stronger as required. Mount pipes to trapeze with 2-piece pipe straps sized for outside diameter of pipe, B-Line B2000 Series.
- I. Wall Supports: Pipes 4" and smaller: Carbon steel J-hanger, B-Line B3690. Pipes larger than 4": Welded strut bracket and pipe straps, Type 31 light welded steel bracket, B-Line B3064. Provide Type 32 or Type 33 for heavier loads.
- J. Floor Supports: Carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. Type 38 adjustable pipe saddle, B-Line B3093 and B3088T base stand; or Type 39, B3090 and B3088 base stand. Pipe saddle shall be screwed or welded to appropriate base stand.
- K. Vertical Supports: Steel riser clamp sized to fit OD of pipe, Type 8, B-Line B3373.

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- L. Supplementary Structural Supports: Design and fabricate supports using structural quality steel bolted framing materials as manufactured by Cooper B-Line. Channels shall be roll formed, 12 gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch by 1-5/8 inch or greater as required by loading conditions. Use clamps and fittings designed for use with the strut system.
- M. Beam Clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration. C-Clamps shall have locknuts and cup point set screws, Type 23, B-Line B351L. Refer to manufacturer's recommendation for setscrew torque. Retaining straps shall be used to maintain the clamps position on the beam where required.
- N. Concrete Inserts: Cast in place spot concrete inserts shall be used where applicable; either steel or malleable iron body, Type 18, B-Line B2500 or B3014. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rod sizes, B-Line N2500 or B3014N series. Continuous concrete inserts shall be used where applicable. Channels shall be 12 gauge, ASTM A1011 SS Grade 33 structural quality carbon steel, complete with Styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert shall have a load rating of 2,000 lbs./ft. in concrete, B-Line B22I, 32I, or 52I. Select channel nuts suitable for strut and rod sizes.
- O. For air conditioning and other vibrating system applications, use a clamp that has a vibration dampening insert and a nylon inserted locknut. For copper and steel tubing use B-Line BVT-Series Vibraclamps. For larger tubing or piping subjected to vibration, use neoprene or spring hangers as required. For base mounted equipment use vibration pads, molded neoprene mounts, or spring mounts as required.
- P. Accessories
 - 1. Hanger Rods shall be threaded both ends, or continuous threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.
 - 2. Shields shall be 180 degree galvanized sheet metal, 12 inch minimum length, 18 gauge minimum thickness, designed to match outside diameter of the insulated pipe, B-Line B3151.
 - 3. Pipe protection saddles shall be formed from carbon steel, 1/8 inch minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12 inch shall have a center support rib.
- Q. Indoor Finishes: Hangers and clamps for support of bare copper piping shall be coated with copper colored epoxy paint, B-Line Dura-Copper®. Additional PVC coating of the epoxy painted hanger shall be used where necessary. Hangers for other than bare copper pipe shall be zinc plated in accordance with ASTM B633; or shall have an electro-deposited green epoxy finish, B-Line Dura-Green®. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR have an electro-deposited green epoxy finish, B-Line Dura-Green®.
- R. Outdoor Finishes: Hangers and strut located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123. Hanger hardware shall be hot dip galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.

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S. Unistrut (MFMA) Manufacturer Metal Framing System:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Unistrut Corporation
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. Thomas & Betts Corporation.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with in-turned lips. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
5. Coating: Unistrut Perma-green or similar.

2.8 BRAIDED EXPANSION LOOPS (MANUFACTURED ONLY, NO FIELD FABRICATED)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Metraflex Co.
 - b. Flex Hose Co., Inc.
 - c. Flexicraft
- B. Flexible loops shall consist of two flexible sections of hose and braid, two 90° elbows, and an 180° return assembled in such a way that the piping does not change direction but maintains its course along a single axis. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180° return, and a drain/air release plug. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be provided in a neutral, pre-compressed or pre-extended condition as required for the application. For steam service, loops must be provided with flexible legs horizontal to prevent condensate buildup. Provide and guide per manufacturer's recommendations. Materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings. For natural gas service, connectors shall be A.G.A. certified. Basis of Design: Flexible expansion loops to be "Metraloop" as manufactured by the Metraflex Company.
- C. Loops for domestic hot water shall be NSF-372 lead free certified.
- D. For tight pipe runs, provide nested loops.
- E. Anchors: Metraflex Model PA anchor clamp or approved equal. Provide light weight anchor for low load; compatible with braided expansion loop manufactures recommendations for "no-thrust" expansion joints. Clamp to pipe.

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- F. Guides: Metraflex Model PGIV shall be of the radial type employing a heavy wall guide cylinder with weld down or bolt down anchor base. A two section guide spider, having 1/8" maximum diametrical clearance with guide cylinder inside diameter, bolted or welded tight to the carrier pipe which slides through the guide cylinder I.D. Cylinder shall be of sufficient size to clear pipe insulation and long enough to prevent over travel of the spider.

2.9 MISCELLANEOUS

- A. Grout: ASTM C 1107, Grade B, non-shrink, and nonmetallic, dry hydraulic-cement grout. Characteristics: Post-hardening, volume adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications. Design Mix: 5000-psi, 28-day compressive strength. Packaging: Premixed and factory packaged.
- B. Equipment shall be vibration isolated to prevent vibration transmission to the building structure.

PART 3 - EXECUTION

3.1 DEMOLITION AND REMOVALS

- A. Refer to Division 1 for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing and mechanical systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap and seal remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap and seal ducts with same or compatible ductwork material.
 - 5. Equipment to be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

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3.2 COMMON REQUIREMENTS

- A. Work shall be conducted, installed, and completed in a neat and professional manner reflecting a minimum level of competent workmanship.
- B. The drawings show the general arrangement of systems and equipment but do not show all required fittings and offsets that may be necessary to connect pipes and ductwork to equipment, and to coordinate with other trades. Provide necessary fittings, offsets and runs based on field measurements and at no additional cost. Coordinate with other trades for space available and relative location of equipment and accessories. Pipe and duct location on the drawings shall be altered by the contractor where necessary to avoid interferences and clearance difficulties.
- C. Fabricate based on field measurements.
- D. Corrections or comments made on the shop or coordination drawings during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for: confirming and correcting quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of other trades; and performing work in a safe and satisfactory manner.
- E. Protection and Cleaning: Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items shall be replaced. Protect finished parts of equipment. Close duct and pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water, chemical, or mechanical injury. At completion of work thoroughly clean fixtures, exposed materials, and equipment.
- F. Provide piping, ductwork, and equipment to allow maximum headroom unless specific mounting heights are indicated. Provide equipment level and plumb, parallel, and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- G. Provide equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- H. Coordinate location of piping, ductwork, sleeves, inserts, hangers, and equipment. Locate to clear other construction, services, and utilities.
- I. Provide piping and ductwork in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- J. Provide systems above accessible ceilings to allow sufficient space for ceiling panel removal.
- K. Verify final equipment locations for roughing-in.
- L. Do not enclose, cover, or put into operation until inspected and approved by authorities having jurisdiction.

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- M. The contract documents indicate required valves, fittings, and accessories. If additional materials are required by code or manufacturer's instructions, they shall be provided at no cost to the owner.

3.3 PIPING INSTALLATIONS

- A. Provide 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.
 - 1. Provide piping to permit valve servicing.
 - 2. Provide equipment and other components to allow right of way for piping installed at required slope.
 - 3. Provide free of sags and bends.
 - 4. Provide unions or flanges at connections to equipment.
 - 5. Provide fittings for changes in direction and branch connections.
 - 6. Make allowances for application of insulation.
- B. Provide piping adjacent to equipment and machines to allow service and maintenance.
- C. Use transition fitting to join dissimilar piping materials. Connect piping in sizes indicated, but not smaller than sizes of unit connections.
- D. Select system components with pressure rating equal to or greater than system operating pressure.
- E. Plastic piping: Piping shall be installed to avoid damage from adjacent light fixtures. In certain construction situations, these plastic pipes may be installed near recessed light fixtures in ceilings. Light fixtures may have exterior temperatures as high as 194°F.
- F. Plumbing: General layout shown, provide piping and components as required by the local plumbing code. A licensed master plumber shall perform or supervise the work and provide layouts, piping, and fittings as required by code.

3.4 PIPING JOINT CONSTRUCTION

- A. Pipe and tube required by the applicable standard to be cleaned and capped shall be delivered to the job site with factory-applied endcaps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture. Protect stored pipe and tube from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor. Protect fittings, flanges, and piping specialties from moisture and dirt. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- B. Joints shall be fabricated, joined, and tested per the piping and fitting manufacturer's instructions. Joint preparation, setting and alignment, joining process, timing, hanger spacing,

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- and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.
- C. Join pipe and fittings according to the following requirements and the relevant specification section specifying piping systems.
 - D. Ream ends of pipes and tubes and remove burrs. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - E. Installer Qualifications
 - 1. Pipe fitters shall be qualified in the procedure used to perform the pipe joining.
 - 2. The contractor is responsible for documenting the qualification and training records of each pipe fitter. Pipe fitters shall have current, formal training on the pipe joining method.
 - 3. Contractor must submit documentation that lists personnel assigned to this project prior to beginning construction who have successfully completed formal training conducted by an authorized manufacturer's representative. The Contractor Training documentation shall be specific to the manufacturer of the pipe and fittings.
 - 4. Personnel's training documentation must be current and have been updated within the past two (2) years. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.
 - 5. Piping Warranty: Contractor shall provide, and document required training and required by the piping system manufacturer in order to maintain the piping manufacturer's warranty.
 - F. Provide dielectric isolation at the connection of the dissimilar piping (copper and steel).
 - G. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
 - H. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
 - I. 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 dry-seal 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.

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J. Press connections:

1. The joints shall be pressed using the tools approved by the manufacturer.
2. Always examine the pipe to ensure it is fully inserted into the fitting prior to pressing the joint.
3. Pipe ends shall be cut on a right angle (square) to the pipe.
4. Copper: The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tools approved by the manufacturer.
5. Steel: Pipe ends shall be reamed chamfered, and paint, lacquer, grease, oil, or dirt shall be removed from the pipe end with an abrasive cloth, or with the Rigid MegaPress pipe end prep tool. Sealing elements shall be verified for the intended use. Visually examine the fitting sealing element to ensure there is no damage. Utilizing a Viega insertion depth inspection gauge mark the tube wall, with a felt tip pen, at the appropriate location, or insert the pipe fully into the fitting and mark the pipe wall at the face of the fitting.

K. Fusion Joints: The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. Fusion equipment operators shall be qualified in the procedure used to perform pipe joining. Fusion equipment operators shall have current, formal training in fusion equipment employed on the project. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.

L. PEX Joints: Provide per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for F1960 connections.

M. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators. Bevel plain ends of steel pipe. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

N. Flanged Joints: Provide appropriate gasket material, size, type, and thickness for service application. Provide gasket concentrically positioned. Use suitable lubricants on bolt threads.

O. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix. PVC Piping: Join according to ASTM D 2855.

3.5 PIPE PENETRATIONS, SLEEVES, & ESCUTCHEONS

A. Pipe penetrations shall be sealed, provide sealants for pipe penetrations

B. Provide allowance for thermal expansion and contraction of copper tubing passing through a wall, floor, ceiling, or partition by wrapping with an approved tape or pipe insulation or by installing through an appropriately sized sleeve.

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- C. Sleeve Clearance: Sleeve through floors, walls, partitions, and beams shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation.
- D. Provide sleeves for pipes passing through concrete and masonry construction. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint. Cut sleeves to length for mounting flush with both surfaces. Provide sleeves in new walls and slabs as new walls and slabs are constructed. Provide steel pipe sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Piping through concrete or masonry shall not be subject to any load from the building construction.
 - 1. Sleeves are not required in drywall construction.
 - 2. Sleeves are not required for core-drilled holes. Provide core drilling as required.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 7.
- F. Escutcheons:
 - 1. Provide escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork.
 - 2. Provide escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 3. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- G. Plastic and copper piping penetrating framing members, and within one-inch of the framing, shall be protected with 10-gauge steel nailing plates. The steel plate shall extend along the framing member a minimum of 1.5" beyond the OD of the pipe or tubing.

3.6 PIPE HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or provide intermediate supports for smaller diameter pipes as specified for individual pipe hangers. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Provide per manufactures recommendations and calculations.
- D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.

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- E. Fastener System Installation: Provide 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. Provide fasteners according to powder-actuated tool manufacturer's operating manual. Provide mechanical-expansion anchors in concrete after concrete is placed and completely cured. Provide fasteners according to manufacturer's written instructions.
- F. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Provide hangers and supports to allow controlled thermal or 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.
- I. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- J. Provide building attachments within concrete slabs or attach to structural steel. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.
- K. Provide for expansion and contraction of the piping system. Since changes in direction in the system are usually sufficient to allow for expansion and contraction, hangers must be placed so as not to restrict this movement
- L. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by plumbing code and ASME B31.9 for building services piping. Piping shall be supported in such a manner as to maintain its alignment and prevent sagging.
- M. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- N. Insulated Piping: Attach clamps and spacers to piping.
 - 1. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - 2. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
- O. Equipment Supports: Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor. Grouting: Place grout under supports for equipment and make bearing surface smooth. Provide lateral bracing, to prevent swaying, for equipment supports.
- P. Metal Fabrications: Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations. Field Welding:

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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. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

- Q. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- R. Hanger and Support Schedule
1. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
 2. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
 3. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- S. Hanger Spacing
1. Support piping and tubing not listed below according to MSS SP-69 and manufacturer's written instructions.
 2. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment. Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading.
 3. Space and provide hangers with the fewest practical rigid anchor points.
 4. Piping shall be supported at intervals sufficiently close to maintain correct pipe alignment and to prevent sagging or grade reversal.
 5. Pipe shall be supported at branch ends and at changes of direction.
 6. Provide hangers for steel piping with the following maximum horizontal spacing and minimum rod sizes:
 - a. NPS 3/4 to 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
 - b. NPS 1-1/4: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - c. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - d. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - e. NPS 2-1/2 to 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 7. Provide hangers for copper piping with the following maximum horizontal spacing and minimum rod sizes:
 - a. NPS 1/2 and 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - b. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - c. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - d. NPS 1-1/2 to 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.

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- e. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - f. Maximum vertical steel and copper pipe attachment spacing: 10 feet.
8. Provide hangers for cast-iron piping with the following maximum horizontal spacing and minimum rod diameters:
- a. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - b. NPS 3: 60 inches with 1/2-inch rod.
 - c. NPS 4 to 5: 60 inches with 5/8-inch rod.
 - d. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
9. Piping Hangers for Plastic Piping:
- a. Hangers shall not compress, distort, cut, or abrade the piping.
 - b. Hangers shall be placed next to the pipe joint not more than 18" from the point joint.
 - c. Maximum horizontal spacing and minimum rod diameters (pipe temperature 100°F or lower).
 - d. Solvent cemented PVC
 - 1) NPS 2 and smaller: 48" with 3/8-inch rod.
 - 2) NPS 2-1/2: 48" with 1/2-inch rod.
 - 3) NPS 3: 48" with 1/2-inch rod.
 - 4) NPS 4: 48" with 5/8-inch rod.
 - e. Solvent cemented CPVC
 - 1) NPS 1 and smaller: 36" with 3/8-inch rod.
 - 2) NPS 1-1/4 to NPS 3: 60" with 3/8-inch rod.
 - 3) NPS 3: 60" with 1/2-inch rod.
 - 4) NPS 4: 60" with 5/8-inch rod.
 - f. Polypropylene (PP)
 - 1) NPS 1 and smaller: 32" with 3/8-inch rod.
 - 2) NPS 1-1/4 to NPS 2: 48" with 3/8-inch rod.
 - 3) NPS 2-1/2 to NPS 3: 48" with 1/2-inch rod.
 - 4) NPS 4 to NPS 5: 48" with 5/8-inch rod.
10. Provide supports for vertical piping every 10 feet.
- T. PEX Piping
1. Horizontal PEX-a Piping Hangers: Provide CTS hangers suitable for PEX-a piping in compliance with the manufacturer's instructions and local codes, with the following maximum spacing:
- a. 1 inch and below: Maximum span, 32 inches.
 - b. 1-1/4 inch and above: Maximum span, 48 inches.

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- c. Note: The above maximum hanger spacing requirements may be extended with the use of a continuous support channel such as Uponor PEX-a Pipe Support.
- 2. Horizontal PEX-a Piping with PEX-a Pipe Channel: Provide hangers for PEX-a piping with horizontal support channel in accordance with local jurisdiction and manufacturer's recommendations, with the following maximum spacing:
 - a. 3/4 inch and below: Maximum span, 6 feet.
 - b. 1 inch and above: Maximum span, 8 feet.
- 3. Vertical PEX-a Piping: Support PEX-a piping with maximum spacing of 5 feet.
- 4. PEX-a Riser Supports: Provide CTS riser clamps at the base of each floor and at the top of every other floor for domestic hot-water systems. Provide mid-story guides between each floor. Provide CTS riser clamps at the base of each floor and at the top of every fourth floor for domestic cold-water systems. Provide mid-story guides.
- U. Support vertical piping independently of connected horizontal piping. Support vertical pipes at base and at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.
- V. Place a hanger within 12 inches of each horizontal elbow.

3.7 VALVE INSTALLATION

- A. Valves shall be installed in accordance with the manufacturer's recommendations.
- B. Provide valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown. Locate valves for easy access and provide separate support where necessary.
- C. Provide valves in horizontal piping with stem at or above center of pipe.
- D. Provide valves in position to allow full stem movement.
- E. Provide strainers on supply side of each control valve and elsewhere as indicated or recommended by component manufacturer to have strainer protection. Provide valved drain and hose connection on strainer blow down connection.
 - 1. Provide with provisions for service clearance.
 - 2. Remove and clean strainer after 24 hours of operation and after 30 days of operation.
- F. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- G. Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at connections to screw-type control valves.

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- H. Provide check valves at each pump discharge and elsewhere as required to control flow direction.
- I. Provide hose end drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

3.8 IDENTIFICATION

- A. Provide equipment markers on each item of scheduled equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated. Locate markers where accessible and visible. Equipment located above the ceiling that requires servicing shall be labeled on the ceiling using a labeling machine.
 - 1. Letters shall be ¼" high, black.
 - 2. Label equipment above ceiling that requires servicing or access. Locate labels on the ceiling grid, adjacent to the ceiling tile that provides the best access to the valve or item that requires servicing.
- B. Piping Identification:
 - 1. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; mechanical rooms; accessible maintenance spaces such as shafts and plenums; and exterior exposed locations as follows:
 - a. Near each valve and control device.
 - b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - c. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - d. At access doors and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - g. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
 - 2. Directional Flow Arrows: Arrows shall be provided to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Relocate mechanical identification materials and devices that have become visually blocked by other work. Clean faces of mechanical identification devices.

3.9 ERECTION OF SUPPORTS AND ANCHORAGES

- A. Fasten wall-hanging items securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated. Fasten recessed-type items to reinforcement built into walls.

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- B. Wood: Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor materials and equipment. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Provide fasteners without splitting wood members. Attach to substrates as required to support applied loads.
- C. Metal: Provide in accordance with Division 5. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor materials and equipment. Field Welding: Comply with AWS D1.1.
- D. Grouting: Provide per manufacturer's instructions. Mix and provide grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors. Clean surfaces that will come into contact with grout. Provide forms as required for placement of grout. Avoid air entrapment during placement of grout. Place grout, completely filling equipment bases. Place grout on concrete bases and provide smooth bearing surface for equipment. Place grout around anchors. Cure placed grout.

3.10 FIRESTOPPING

- A. Provide through-penetration firestop systems. Refer to Division 7 for materials. Seal penetrations through fire-or smoke-rated wall, partition, ceiling, or roof assemblies with firestopping systems. Refer to Architectural plans for location of rated assemblies.

3.11 PAINTING

- A. Painting of plumbing and mechanical systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.12 ROOFING

- A. Refer to Division 7.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- C. Roof Pipe Stand Installation: Provide per manufactures recommendations and calculations. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount them on a smooth roof surface. Do not penetrate roof membrane. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.
- D. Roof Pipe Penetrations: Provide curb system with cover and pipe boots.
- E. Do not locate mechanical equipment within 10 feet of the roof edge.

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3.13 PROJECT CLOSEOUT

A. Starting and Adjusting

1. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace them with new units, and retest.
2. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
3. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Provide commissioning per manufacturer's instructions. This start-up shall include verification of proper installation, system initiation, adjustment, and fine tuning.
5. Start-up shall not be considered complete until the sequence of operation, including alarms, has been sufficiently demonstrated to the Owner or Owner's designated representative. This jobsite visit shall occur only after hook-ups, tie-ins, and terminations have been completed and signed-off on the manufacturer's start-up request form.

B. Follow Closeout procedures as per Division 1.

C. Provide Demonstration and Training in accordance Division 1.

D. Provide Project Record Documents in accordance with Division 1. In addition, per ASHRAE 90.1-2016: Provide record drawings of the actual installation to the building owner. Record drawings shall include, as a minimum, the location and performance data on each piece of equipment; general configuration of the duct and pipe distribution system, including sizes; and the terminal air or water design flow rates.

E. Provide Operation and Maintenance information in accordance with Division 1. In addition, per ASHRAE 90.1: Provide an operating manual and a maintenance manual to the building owner. Manuals shall include, at a minimum, the following:

1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
2. Operation manuals and maintenance manuals for each piece of equipment and system requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
3. Names and addresses of at least one service agency.
4. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined set points shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments.

END OF SECTION 230500

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

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.
- B. Related Sections include the following:
 - 1. Division Section: "Common Work Results"

1.2 SUMMARY

- A. Testing, Adjusting, and Balancing

1.3 INFORMATIONAL SUBMITTALS

- A. Reports:
 - 1. TAB Report: Submit the complete testing, adjusting, and balancing report, including any drawings indicating air outlets, thermostats, and equipment identified to correspond with data sheets.
 - 2. Reports shall be on TABB/SMACNA, AABC, or NEBB forms that indicate information addressing each of the testing methods, readings, and adjustments.
- B. Closeout Submittals: Provide complete copy of TAB report. Include report in Operation and Maintenance Manual.

1.4 QUALITY ASSURANCE

- A. An independent entity shall perform the TAB work.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- D. TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

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PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed, complete, and operable.
 3. Verify HVAC control system is operating within the design limitations.
 4. Confirm that the sequences of operation comply with Contract Documents.
 5. Automatic and manual dampers are operable and fully open.
 6. Verify that controllers are calibrated and function as intended.
 7. Verify that controller set points are as indicated.
 8. Verify the operation of lockout or interlock systems.
 9. Verify the operation of valve and damper actuators.
 10. Verify that controlled devices are properly installed and connected to correct controller.
 11. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
 12. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
 13. Suitable access to balancing devices and equipment is provided.
 14. Thermal overload protection is in place for equipment.
 15. Start-up air filters are removed.
 16. Final filters are clean and properly installed.
 17. Duct and fan systems are clean.
 18. Fans are rotating correctly.
 19. Life safety and volume dampers are in place and open.
 20. Air coil fins are cleaned and combed.
 21. Access doors are closed, and duct end caps are in place.
 22. Air outlets are installed and connected.
 23. Hydronic systems are pressure tested, flushed, filled, and properly vented.
 24. Leak testing on duct system has been performed.
 25. Pumps are rotating correctly.
 26. Start-up/construction strainers have been removed and all permanent strainers are clean and in place.
 27. Gauges and/or test ports are properly located for balancing.
 28. Service and balance valves are fully open.
- B. If deficiencies are evident, submit Deficiency Report to Architect. Do not begin testing, adjusting, and balancing of environmental systems until deficiencies have been remedied.

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3.2 AIR SYSTEMS PROCEDURES

A. Adhere to the follow procedure:

1. TABB – SMACNA TAB Procedural Guide, with particular focus on the following chapters: Preliminary TAB Procedures, General Air System TAB Procedures, & TABB Procedures for Specific Air Systems.
2. AABC – National Standards for Total System Balance.
3. NEBB – Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

B. Minimum air procedures shall include the following:

1. Provide TAB for all air systems and components.
2. Test and adjust fan RPM to design requirements.
3. Test and record motor full load nameplate rating and actual ampere draw.
4. Test and record system static pressures, fan suction, and discharge.
5. Adjust all main supply and return air duct to within tolerances of proper design CFM.
6. Test and adjust each diffuser, grille, and register. Reading and tests of diffusers, grilles, and registers shall include design velocity (FPM) and adjusted velocity, design CFM, and adjusted CFM.
7. Test and record outside air, mixed air, and discharge temperatures (D.B. for heating cycle, D.B. and W.B. for cooling cycle).
8. In coordination with the BAS contractor, set adjustments of automatically operated dampers to operate as specified, indicated and/or noted.
9. Test and adjust air handling and distribution systems to provide required supply, return, outside, and exhaust air quantities within design tolerance.
10. Make air velocity measurements in ducts by Pitot tube traverse across entire cross-sectional area of duct in accordance with SMACNA equal area method or Log Linear method.
11. Measure air quantities at all air inlets and outlets.
12. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels.
13. Vary total system air quantities by adjustment of fan speeds. Provide drive changes recommendations. Vary branch air quantities by damper regulation.
14. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for loading of filters and coils.
15. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions within specified tolerances.

C. Set system's airflow rates within the following tolerances:

1. Air Handling Systems: Adjust to within plus 10 percent of outlet total plus allowable leakage rate.
2. Air Outlets and Inlets: Adjust total to within plus or minus 10 percent of design for the space.
3. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

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3.3 HYDRONIC SYSTEM PROCEDURES

A. Adhere to the follow procedure:

1. TABB – SMACNA TAB Procedural Guide, with particular focus on the following chapter: Hydronic System TAB Procedures.
2. AABC – National Standards for Total System Balance.
3. NEBB – Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

B. Hydronic balancing shall include the following minimum data:

1. Provide TAB for all hydronic and domestic water systems and components.
2. Prepare itemized equipment schedules listing all heating and/or cooling elements and equipment in the systems to be balanced. List in order on equipment schedules, by pump or zone according to the design, all heating and/or cooling elements, all zone balancing valves, and circuit pumps, ending with the last items of equipment or transfer element in the respective zone or circuit. Include on schedule sheet column titles listing the location, type of element or apparatus, design conditions, and measured conditions. Prepare individual pump report sheets for each zone or circuit.
3. Adjust hydronic systems to provide plus or minus 10 percent of required design quantities.
4. Use calibrated Venturi tubes, orifices, metered fittings, pressure gages, and direct-reading instrumentation to determine flow rates for system balance. Where flow-metering devices are not installed, flow balance on temperature difference across various heat transfer elements in the system is acceptable.
5. 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.
6. Effect system balance with automatic control valves fully open to heat or cooling transfer elements.
7. Adjust hydronic distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

C. Set system's water flow rates within the following tolerances:

1. Hydronic Systems: Adjust to within 10 percent of design flow.
2. Hydronic terminal devices: Adjust to within plus or minus 10 percent of design flow.

3.4 ADJUSTING

- A. Recorded data shall represent actual measured or observed conditions.
- B. Permanently mark the setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- C. Final report to include identification of all key outlets, key branches, and key trunks in each air system that shows a critical path of no dampening from the fan to terminal device.

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- D. Final report to include identification of all key terminal devices, key branches, and key trunks in each hydronic system that shows a critical path of no throttling of valves from the pump to terminal device.
- E. Leave systems in proper working order by replacing guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

END OF SECTION 230593

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SECTION – 230700 – MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 7 for firestopping materials and requirements for penetrations through fire and smoke barriers.
 - 2. Division 23 Section "Common Work Results for Mechanical"

1.2 SUMMARY

- A. This Section includes insulation and related components for Division 22 & Division 23.

1.3 ACTION SUBMITTALS

- A. Product Data: Identify thermal conductivity, Greenguard Certification, thickness, and jackets (both factory and field applied, if any), for each type of product indicated. For adhesives and sealants, provide documentation including printed a statement of VOC content.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
- C. Indoors: Materials shall have a flame spread index of less than 25 and a smoke developed index of less than 50 when tested in accordance with ASTM E 84, latest revision.
- D. Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

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- E. Provide accessory materials as part of insulation work under his section shall include closure materials, adhesives, mastics, and support materials; shall be as recommended by insulation material manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.
- C. Store tapes, adhesives, mastics, cements, and insulation materials in ambient conditions in accordance with the recommendations of the manufacturer.
- D. Follow manufacturer's recommended handling practices.
- E. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- F. Fiber Glass and Mold: Contractor shall take precaution to protect insulation. Any fiber glass insulation that becomes wet or torn should be replaced at no additional cost. Air handling insulation used in the air stream must be discarded if exposed to water.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields. Coordinate clearance requirements with other trades for insulation application.
- B. Schedule insulation application after testing systems. Insulation application may begin on segments of systems that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Certainteed
 - 2. Knauf
 - 3. Owens-Corning

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4. John Mansville
5. Armstrong
6. Aeroflex USA
7. Nomaco K-Flex
8. Pabco.

2.2 PIPING INSULATION MATERIALS

A. Glass Fiber:

1. Knauf 1000° Pipe Insulation with ECOSE Technology meeting ASTM C547 Type IV Grade A, ASTM C585, and ASTM C795; rigid, molded, noncombustible per ASTM E136; k value: ASTM C335, 0.23 at 75°F mean temperature. Maximum Service Temperature: 1000°F, or Johns Manville's Micro-Lok® HP meeting ASTM C547, Type I, maximum service temperature of 850°F meeting the other requirements. Vapor Retarder Jacket: ASJ/SSL conforming to ASTM C1136 Type I, secured with self-sealing longitudinal laps and butt strips.
2. PVC Fitting Covers: The Proto Fitting Cover System or Johns Manville Zeston® polyvinyl chloride (PVC) parts shall consist of one piece and two piece pre-molded high impact UV-resistant PVC fitting covers with fiberglass inserts and accessories, which include elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings. Fittings shall be made of Zeston® or LoSMOKE® grade PVC, 25/50 rated per ASTM E-84. Thermal Value of fiberglass insert: K value of 0.26 at 75°F; resistance to fungi and bacteria. (ASTM G 21, ASTM G 22): does not promote growth of fungi or bacteria.

B. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Materials shall have a maximum thermal conductivity of 0.27 Btu-in/h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
4. Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure-A, latest revision.
5. Provide Armaflex WB finish for outdoor exposed piping.

C. Field-Applied Jackets For Piping: ASTM C 921, Type 1, unless otherwise indicated.

1. PVC: Johns Manville's Zeston® PVC fittings, jacketing, and accessories or Proto Corporation 25/50 or Indoor/Outdoor, UV-resistant fittings, jacketing and accessories, white. The fitting cover system consists of pre-molded, high-impact PVC materials with fiber glass inserts. Fiber glass insert has a thermal conductivity (k value) of 0.26 at 75° F mean temperature. Closures: stainless steel tacks, matching PVC tape, or PVC adhesive per manufacturer's recommendations.

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2. Metal jackets: provide with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
3. Aluminum Jacket: Factory cut and rolled to required size. Comply with ASTM B 209, 3003 alloy, and H-14 temper. Finish and Thickness: Corrugated finish, 0.010 inch thick. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and Kraft paper. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.3 DUCTWORK INSULATION MATERIALS

- A. Flexible Fiber Glass Blanket: Glass Mineral Wool Blanket Insulation: Glass Mineral Wool bonded with a bio-based thermosetting resin. Comply with ASTM C 553, Types I, II, and III, ASTM C 1136 Type II, and ASTM C 1290, Type III. UL/ULC Classified per UL 723 for FSK, FHC 25/50 per ASTM E 84 for PSK only.
 1. Factory-applied jacket: ASJ: White, Kraft paper, fiberglass reinforced scrim with aluminum foil backing; complying with ASTM C 1136, Type I.
 2. Basis-of-Design Product: Subject to compliance with requirements, provide Knauf Insulation; Atmosphere Duct Wrap.
 3. Density: 1.5 PCF
 4. R-Value: R6.0 minimum for 1-1/2" thick blanket ($k=0.25$).
- B. Rigid Fiber Glass Board: Johns Manville's 817 Series Spin-Glass® or Knauf Insulation Board with ECOSE Technology meeting ASTM C 612 Type IA and IB; rigid. Maximum Service Temperature: 450°. Density: Minimum 3.0 PCF; R4.2 per inch. Vapor Retarder Jacket: ASJ conforming to ASTM C1136 Type I, or FSK or PSK conforming to ASTM C1136 Type II in combination with protective jacket where necessary. R-Value: R6.0 minimum for 1-1/2" thick blanket ($k=0.25$).
- C. Exterior Ductwork:
 1. Insulation: Rigid foam insulating sheathing, complying with ASTM C 1289; closed cell polyisocyanurate, CFC- and HCFC-free.
 - a. Thermal Resistance, ASTM C 518: R12 Minimum.
 - b. Compressive Strength, ASTM D 1621: 16 psi or greater.
 - c. Flexural Strength, ASTM C 203: 40 psi or greater.
 - d. Water Absorption, ASTM C 209: 0.1 percent by volume.
 - e. Water Vapor Permeance, ASTM E 96, 0.05 perms.
 2. High-performance jacketing: VentureClad-1577, Polygard-Alumagard All-Weather, or approved equal; high performance jacketing product shall perform well over a wide temperature range; -30°F to +300°F service temperature.
 - a. Zero permeability, absolute vapor barrier; High puncture and tear resistance
 - b. Contain tested and approved mold inhibiting agents.

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- c. A 5-ply self-adhesive material shall be installed easily with no off-site fabrication required. The cold weather acrylic adhesive shall apply easily at temperatures as cold as minus 10°F.
- d. Flame spread/smoke developed: 10/20 (UL 723)
- e. 6-mil thickness (PSTC-133); Provide in natural aluminum stucco embossed finish.

PART 3 - EXECUTION

3.1 GENERAL APPLICATION REQUIREMENTS

- A. Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature. Insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification. Store tapes, adhesives, mastics, cements, and insulation materials in ambient conditions in accordance with the recommendations of the manufacturer. Follow manufacturer's recommended handling practices. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades. Contractor shall take precaution to protect insulation. Any fiber glass insulation that becomes wet or torn should be replaced at no additional cost. Air handling insulation used in the air stream must be discarded if exposed to water.
- B. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application. Verify that systems to be insulated have been tested and are free of defects. Verify that surfaces to be insulated are clean and dry. Proceed with installation only after unsatisfactory conditions have been corrected. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin. Ensure that pipe and fitting surfaces over which insulation is to be installed are clean and dry. Ensure that insulation is clean, dry, and in good mechanical condition with factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.
- C. Installer Qualifications: Skilled mechanics shall have successfully completed an apprenticeship program or another craft training program.
- D. Provide insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout, including the length of ducts and fittings, valves, and specialties. Provide per "National Commercial & Industrial Insulation Standards" – MICA Manual.
- E. Provide insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each system as specified in insulation system schedules.

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- F. Provide accessories compatible with insulation materials and suitable for the service.
- G. Provide insulation with longitudinal seams at top and bottom of horizontal pipe runs and equipment. Provide multiple layers of insulation with longitudinal and end seams staggered.
- H. There shall be no glass fibers exposed to the air. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- J. Jackets And Finishes: Draw jacket tight and smooth. 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. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c. For below ambient services, apply vapor-barrier mastic over staples. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- K. Keep insulation materials dry during application and finishing.
- L. Provide insulation over fittings, valves, and specialties, with continuous thermal and the least number of joints practical.
- M. Provide removable insulation covers at fittings and equipment that require servicing and locations with service requirements.
- N. Locate seams in the least visible location.
- O. Cold surfaces that may "sweat" must be insulated. Vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal.
 - 1. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
 - 2. Hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
 - 3. Seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 4. Provide insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity.
 - 5. Extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic. Provide insert materials and provide insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- P. For above-ambient services, do not install insulation to the following: testing agency labels and stamps, nameplates, and cleanouts.

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- Q. Insulation thicknesses and installations shall meet or exceed the requirements of the local energy code, or thicknesses indicated, whichever is of superior insulating performance. If piping type is omitted from list below, provide insulation per energy code or as per similar duty.
- R. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- S. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- T. Insulate instrument connections for specialties (examples: thermometers, sensors, etc.) 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.
- U. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- V. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- W. Penetrations
 - 1. Division 7 for firestopping materials and requirements for penetrations through fire and smoke barriers.
 - 2. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Provide insulation continuously through walls and partitions.
 - 3. Insulation Installation at Roof: Provide insulation continuously through penetrations.
 - a. Seal penetrations with flashing sealant.
 - b. For applications requiring only indoor insulation, terminate insulation above roof/wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, provide insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - c. Extend jacket of outdoor insulation outside roof/wall flashing at least 2 inches below top of roof flashing.
 - d. Seal jacket to roof/wall flashing with flashing sealant.
 - 4. Insulation Installation at Fire-Rated Penetrations:
 - a. Fire Dampers: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - b. Pipe or duct penetrations (no fire damper): Provide insulation continuously through penetrations of fire-rated walls and partitions. Comply with requirements in Division 7 for firestopping and fire-resistive joint sealers.

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3.2 INSTALLATION OF PIPING INSULATION

- A. Metal shields shall be provided between hangers or supports and the piping insulation.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement and finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 2. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section close to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 3. Insulate using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement.
 - 4. For below-ambient services, provide a design that maintains vapor barrier.
 - 5. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Provide 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.
 - 6. 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.
 - 7. For services not specified to receive a field-applied jacket except for flexible elastomeric, provide 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. Flexible Elastomeric Insulation
 - 1. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 2. Insulation Installation on Pipe Flanges: Provide pipe insulation to outer diameter of pipe flange. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 3. Insulation Installation on Pipe Fittings and Elbows: Provide mitered sections of pipe insulation. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 4. Insulation Installation on Valves and Pipe Specialties: Provide preformed valve covers manufactured of the same material as pipe insulation when available. When preformed valve covers are not available, provide cut sections of pipe and sheet insulation to valve

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body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. Provide insulation to flanges as specified for flange insulation application. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

5. After the adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating. Prior to applying the finish, the insulation shall be wiped clean with denatured alcohol. The finish shall not be tinted. To insure good adhesion, the temperature should be above 50°F during application and drying.
6. Outdoor exposed piping shall be painted with two coats of Armaflex WB Finish. Prior to applying the Finish, the insulation shall be wiped clean with denatured alcohol. The Finish shall not be tinted. Outdoor exposed piping shall have seams located on the lower half of the pipe.

3.3 PIPE APPLICATION SCHEDULE

- A. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements. For piping systems not indicated, insulate to with a similar thickness and type as those specified. Insulation thicknesses and installations shall meet or exceed the requirements of the local energy code, or thicknesses indicated, whichever is of superior insulating performance.
- B. Domestic hot water:
 1. Runouts and non-recirculated portions: Glass Fiber 1/2" thickness.
 2. Recirculating piping including the supply and return: 1-1/4" and less: Glass Fiber, 1" thickness; 1-1/2 and larger: Glass Fiber, 1.5" thickness.
- C. Domestic cold water: Glass Fiber, 1/2" thickness.
- D. Rainwater conductors: Glass Fiber, 1" thickness. Provide for horizontal piping and any vertical piping within 10 feet of the roof drain.
- E. Roof Drain Bodies: Flexible Elastomeric, 1/2" thickness. Alternative: Roof drain bowls may be insulated with 2" of closed-cell spray-foam provided by Division 7. Coordinate with Division 7.
- F. Electric water coolers: insulate the trap and drain piping within 10 feet of the cooler to prevent sweating; Flexible Elastomeric, 1/2" thickness.
- G. AC pan drain or other cold drain piping: Flexible Elastomeric, 1/2" thickness.
- H. Refrigerant:
 1. Pipe size 1-1/4" and less: Glass Fiber, 3/4" thickness.
 2. Pipe size 1-1/2" and larger: Glass Fiber, 1" thickness.

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3. VRF: Insulate piping in accordance with VRF manufacturer's instructions.
4. Ductless split: 3/4" Armaflex for liquid and gas piping; and/or insulated line kits as specified in Section 238130.

I. Heating hot water supply and return:

1. Pipe size 1-1/4" and less: Glass Fiber; 1-1/2" thickness.
2. Pipe size 1-1/2" and larger: Glass Fiber; 2" thickness.
3. Insulation is not required for exposed piping through floor for convectors and radiators.
4. Insulation is not required strainers, control valves, unions, and balancing valves associated with piping 1" or less diameter. Insulate piping to within approximately 3/4-inch of uninsulated items.

3.4 INSTALLATION OF DUCTWORK INSULATION

A. Flexible Fiberglass Blanket Insulation Installation:

1. Secure with adhesive and insulation pins. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces. Apply adhesive to entire circumference of ducts and to surfaces of fittings and transitions.
2. Firmly butt joints.
3. Provide either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts.
4. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
5. Provide insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Provide insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces. Apply adhesive to entire circumference of ducts and to surfaces of fittings and transitions.
2. Provide either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts.
3. Provide insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Provide insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

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4. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. For ducts and plenums with surface temperatures below ambient, provide a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Provide vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal. Provide vapor stops for ductwork and plenums operating below 50°F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
- D. Fire-rated insulation system installation: Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating. Insulate duct access panels and doors to achieve the same fire rating as duct.

3.5 DUCTWORK APPLICATION SCHEDULE

- A. For duct systems not indicated, insulate to with a similar thickness and type as those specified. Insulation thicknesses and installations shall meet or exceed the requirements of the local energy code, or thicknesses indicated, whichever is of superior insulating performance.
- B. Application schedules identify ductwork thickness, and jacket requirements. For duct systems not indicated, insulate to with a similar thickness and type as those specified. Insulation thicknesses and installations shall meet or exceed the requirements of the local energy code, or thicknesses indicated, whichever is of superior insulating performance.
- C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment: Flex connectors, metal ducts with duct liner, factory-insulated flexible ducts, factory-insulated plenums, casings, and access doors.
- D. Rooftop (outdoor) DOAS Ductwork: 2-1/2" Rigid Roof Insulation Board with high performance jacket; R12 minimum.
- E. Indoor DOAS Ductwork:
 1. SA: None
 2. RA: None

END OF SECTION 230700

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SECTION 230900 – DIRECT DIGITAL CONTROL (DDC) SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. General: 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. The control system shall be seamlessly integrated with the State of Maine Bureau of General Services' Honeywell EBI Building Automation System (BAS) to enable monitoring and control of mechanical systems installed under the scope of this project through the central BAS. The project scope shall include but not necessarily be limited to the following:
 - 1. Integrate with the new DOAS unit controller, via BACnet interface.
 - 2. Control for fin tube radiation throughout the renovated spaces.
 - 3. Integrate with VRF/Heat Pump controller via BACnet interface.
 - 4. Integrate with the existing Siemens DDC temperature control platform currently in place at the MCJA campus.
 - 5. Provide expandability for future upgrades at the MCJA campus
- B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.
- C. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms shall be BACnet objects.
- D. The Controls Contractor's work shall consist of the provision of all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, project-specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, warranty, specified services and items required by the Contract that are required for the functional turn-key operation of the complete and fully functional Controls Systems. Documents are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, which are required to meet the functional intent, shall be provided without additional cost to the Owner.
- E. Provide all labor, materials, equipment, and service necessary for a complete and operating BAS.

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F. Related Sections include the following:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
2. Division 13 Section "Fire Alarm"
3. Division 23 Section "Common Work Results"
4. Division 23 Sections with controller interfaces shall be integrated with the work of this Section.
5. Division 23 Section "Testing, Adjusting, and Balancing"
6. Division 26

1.2 SUBMITTALS

A. Product Data and Shop Drawings: Meet requirements of Division 1. In addition, the contractor shall provide shop drawings or other submittals on hardware, software, and equipment to be installed or provided. No work may begin on any segment of this project until submittals have been approved for conformity with design intent. Provide drawings in PDF format. When manufacturer's cutsheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawing shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Submittals shall include:

1. DDC System Hardware

- a. A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
- b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
 - 1) Direct digital controllers (controller panels)
 - 2) Transducers and transmitters
 - 3) Sensors (including accuracy data)
 - 4) Actuators
 - 5) Valves
 - 6) Relays and switches
 - 7) Control panels
 - 8) Power supplies
 - 9) Batteries
 - 10) Operator interface equipment
 - 11) Wiring
- c. Wiring diagrams and layouts for each control panel. Show termination numbers.

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- d. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Central System Hardware and Software
- a. A complete bill of material of equipment used indicating quantity, manufacturer, model number, and relevant technical.
 - b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
 - 1) Central Processing Unit (CPU) or web server
 - 2) Monitors
 - 3) Keyboards
 - 4) Power supplies
 - 5) Battery backups
 - 6) Interface equipment between CPU or server and control panels
 - 7) Operating System software
 - 8) Operator interface software
 - 9) Color graphic software
 - 10) Third-party software
 - c. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show interface wiring to control system.
 - d. Network riser diagrams of wiring between central control unit and control panels.
3. Controlled Systems
- a. Riser diagrams showing control network layout, communication protocol, and wire types.
 - b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
 - c. A schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - d. An instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - e. A mounting, wiring, and routing plan-view drawing. The design shall take into account HVAC, electrical, and other systems' design and elevation requirements.
 - f. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
 - g. A point list for each control system. Indicate alarmed and trended points.

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4. Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.
5. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.

B. Schedules

1. Within one month of contract award, provide a schedule of the work indicating the following:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and equipment and expected lead times.
 - e. Milestones indicating possible restraints on work by other trades or situations.
2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

C. Project Record Documents. Upon completion of installation, submit three copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and shall include:

1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD compatible files on magnetic or optical media (file format: .DWG, .DXF, .VSD, or comparable) and as 11" x 17" prints.
2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs.
3. Operation and Maintenance (O&M) Manual.
4. As-built versions of submittal product data.
5. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
6. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
7. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
8. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
9. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
10. Graphic files, programs, and database on magnetic or optical media.
11. List of recommended spare parts with part numbers and suppliers.

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12. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
13. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
14. Licenses, guarantees, and warranty documents for equipment and systems.
15. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
16. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training.

1.3 QUALITY ASSURANCE

- A. All products used in this project installation shall be new and currently under manufacture and shall have been applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the owner's representative in writing. Spare parts shall be available for at least five years after completion of this contract.
- B. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer. Use only employees who are qualified, skilled, experienced, manufacturer trained and familiar with the specific equipment, software and configurations to be provided for this Project.
 1. Installer shall have an established working relationship with Control System Manufacturer.
 2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.
- C. Provide a complete, neat and workmanlike installation.
- D. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- G. Comply with ASHRAE 135 for DDC system control components.
- H. The contractor shall protect all work and material from damage by his/her work or employees. The contractor shall be responsible for his/her work and equipment until finally inspected,

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tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

1.4 CONTRACTOR QUALIFICATIONS

- A. Qualified Bidders: System shall be as manufactured, installed, and serviced by the following. The new control systems shall be seamlessly compatible with the State of Maine Bureau of General Services' Honeywell EBI Building Automation System.
1. Maine Controls - Distech
 2. Johnson Controls, Inc.
 3. Honeywell
 4. Siemens
 5. Trident - Automated Logic
 6. Trane
 7. XL Automation
 8. Approved bidders. Bids from other vendors, franchised dealers, manufacturer's representatives, or from contractors who are authorized to represent the above named manufacturers must be pre-approved.
- B. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- C. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, and controllers. All other products specified herein (e.g., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.
- D. Longevity: The Facilities Management System contractor shall have a minimum of ten years' experience installing and servicing computerized BAS. All subcontractors utilized by the BAS contractor shall have a minimum of five-year experience within their appropriate trades.
- E. Past Projects: The BAS contractor shall have completed a minimum of ten projects within the last five years that are at least equal in dollar value and scope to this project. A list of similar projects, dollar volume, scope, contact name and contact number shall be provided by the BAS contractor if asked for by the owner.
- F. Personnel, Coverage and Response Capabilities: The BAS contractor shall have a minimum of ten full time electronic service personnel within a 120-mile radius of the project location. One of the five full time electronic service personnel must work within a 60-mile radius of the project location.
- G. The BAS contractor shall have an established 24-hour emergency service organization. A dedicated telephone number shall be provided to the owner for requesting emergency service. A maximum of four-hour, electronic service technician on sight, response time shall be guaranteed by the BAS contractor.

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- H. Parts Stocking: The BAS contractor shall have an independently verifiable inventory of electronic service parts. This electronic service parts inventory must have a worth of at least \$100,000 per year over the last five years.

1.5 COORDINATION

- A. Where the mechanical work will be installed near, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition.
- B. Coordinate details of telephone line, internet service provider, and associated requirements.
- C. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.
- D. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.
- E. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the controls system specified in this section. These controls shall be integrated into the system and coordinated by the contractor.
- F. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.
- G. Sheet Metal Subcontractor:
 - 1. Installation of duct-mounted control devices.
 - 2. Access doors where indicated and as required for proper servicing.
 - 3. Furnishing and installing of smoke dampers and actuators required for duct smoke isolation. The BAS contractor shall interlock these dampers to the air systems as described in Sequences of Operation.
- H. HVAC Contractor:
 - 1. Installation of immersion wells and sockets, along with associated shut-off cocks.
 - 2. Installation of pipe-mounted control devices.
- I. Testing and Balancing Contractor:
 - 1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
 - 2. The contractor shall provide training in the use of these tools.
 - 3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.

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4. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.
 - J. Electrical Subcontractor: Complying with the principle of "unit responsibility" all electrical work for automatic controls, except as otherwise specified, or shown on the electrical drawings shall be included in Division 23. Electrical work shall, in general, comply with the following, unless otherwise directed by Division 26:
 1. Power wiring.
 2. All control wiring shown on electric plans such as unit heater line-voltage room thermostats.
 3. Coordinate duct smoke detectors with the electrical contractor.
 4. All electrical work shall comply with the N.E.C. and local electrical codes.
 5. All safety devices shall be wired through both hand and auto positions of motor starting device to insure 100% safety shut-off.
 6. Provide auxiliary contacts as required for interlock by BAS Contractor; the supplier shall estimate an allowance of at least one auxiliary contract per starter.
 - K. Coordinate with controls specified in other sections of divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the BAS contractor as follows:
 1. All communication media and equipment shall be provided as specified hereinafter.
 2. Each supplier of a control product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.
 3. The BAS contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.
 4. The BAS contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
 5. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
 - B. System Software: Update to latest version of software at Project completion.

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1.7 WARRANTY

- A. Refer to Division 1 Requirements.
- B. At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the engineer, the engineer shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty. All work shall have a single warranty date, even when the owner has received beneficial use due to an early system start-up.
- C. All components, system software, and parts supplied by the BAS contractor shall be guaranteed against defects in materials and workmanship for one year from acceptance date. The BAS contractor at no charge shall furnish Labor to repair, reprogram, or replace components during the warranty period. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 hours during normal business hours.
- D. Provide remote service diagnostic monitoring from the nearest service location. At the request of the owner, a service diagnostic call will be made to troubleshoot and resolve (if possible) any reported system complaints. The owner will provide a dedicated telephone line for connection to the system.
- E. Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies as identified by the contractor shall be provided at no charge during the warranty period. Any upgrades or functional enhancements associated with the above-mentioned items also can be provided during the warranty period for an additional charge to the owner by purchasing an in-warranty service agreement from the contractor. Written authorization by the owner must, however, be granted prior to the installation of any of the above-mentioned items.

PART 2 - PRODUCTS

2.1 BUILDING AUTOMATION SYSTEM

- A. DDC system shall consist of a high-speed, peer-to-peer network of distributed DDC controllers, other network devices, operator interfaces, and software. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules.
- B. Provide new wiring and network devices as required to provide a complete and workable control network.

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C. DDC system shall be Web based or Web compatible.

1. Web-Based Access to DDC System:

- a. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet through Owner's LAN.
- b. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
- c. Web access shall be password protected.

2. Web-Compatible Access to DDC System:

- a. Operator workstation shall perform overall system supervision and configuration, graphical user interface, management report generation, and alarm annunciation.
- b. DDC system shall support Web browser access to building data. Operator using a standard Web browser shall be able to access control graphics and change adjustable set points.
- c. Web access shall be password protected.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated. System Performance Objectives:

1. DDC system shall manage HVAC systems.
2. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
3. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
4. DDC system shall operate while unattended by an operator and through operator interaction.
5. DDC system shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

B. DDC System Data Storage:

1. Include server(s) with disk drive data storage to archive not less than 36 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
2. When logged onto a server, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
3. Server(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information

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- management; for alarm annunciation; and for operator interface tasks and controls application management.
4. Server(s) shall use IT industry-standard database platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE).
- C. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
 2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
 3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
 4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
 5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 sec.
 6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
 7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
 8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.
 9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
 10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed below.
 11. Measured Variable and Reported Accuracy
 - a. Space Temperature: $\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$)
 - b. Ducted Air: $\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$)
 - c. Outside Air: $\pm 1.0^{\circ}\text{C}$ ($\pm 2^{\circ}\text{F}$)
 - d. Water Temperature: $\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$)
 - e. Relative Humidity: $\pm 5\%$ RH
 - f. Water Flow: $\pm 2\%$ of full scale
 - g. Air Pressure (ducts): ± 25 Pa (± 0.1 in. w.g.)
 12. Control Stability and Accuracy
 - a. Air Pressure: ± 50 Pa (± 0.2 in. w.g.); Range of Medium: 0–1.5 kPa (0–6 in. w.g.)
 - b. Airflow: $\pm 10\%$ of full scale
 - c. Space Temperature: $\pm 1.0^{\circ}\text{C}$ ($\pm 2.0^{\circ}\text{F}$)
 - d. Duct Temperature: $\pm 1.5^{\circ}\text{C}$ ($\pm 3^{\circ}\text{F}$)
 - e. Humidity: $\pm 5\%$ RH
 - f. Fluid Pressure: ± 10 kPa (± 1.5 psi); Range of Medium: 1–150 psi

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- D. Environmental Conditions for Controllers, Gateways, Routers, Instruments and Actuators: Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application. Products shall be protected with NEMA enclosures suitable for the location where installed.
- E. Continuity of Operation after Electric Power Interruption: Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.3 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.
- B. Provide new wiring and network devices as required to provide a complete and workable control network.
- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
- E. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
- F. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 23 09 93. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- G. Workstations, Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.
- H. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

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2.4 DDC EQUIPMENT

- A. The Operator Workstation or server shall conform to the BACnet Operator Workstation (B-OWS), or BACnet Advanced Workstation (B-AWS) device profile as specified in ASHRAE/ANSI 135 BACnet Annex L.
- B. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information.
- C. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135, BACnet Annex J.
- D. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 - 3. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, anti-short-cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs
 - c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - d. Remote communications.
 - e. Maintenance management.
 - 4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 - 5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

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- E. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 - 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include given communications; discrete/digital, analog, and pulse I/O; and monitoring, controlling, or addressing data points.
 - 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 - 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- F. 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.
 - 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 three-point, floating-type electronic actuators.
 - 7. Universal I/Os: Provide software selectable binary or analog outputs.
- G. 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-mic.sec. 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.
- H. 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.

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2.5 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 - 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics, monitor system and report failures.
 - 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
 - 4. Enclosure: Dustproof rated for operation at extreme ambient temperatures.

2.6 SENSING DEVICES

- A. Where feasible, provide the same sensor type throughout the project. Avoid using transmitters unless absolutely necessary.
- B. Thermistors: Precision thermistors may be used in applications below 200°F. Sensor accuracy over the application range shall be 0.36°F or less between 32 to 150°F. Stability error of the thermistor over five years shall not exceed 0.25°F cumulative. A/D conversion resolution error shall be kept to 0.1°F. Total error for a thermistor circuit shall not exceed 0.5 °F.
- C. Resistance Temperature Detectors (RTDs): Provide RTD sensors with platinum elements compatible with the digital controllers. Encapsulate sensors in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32°F. Temperature sensor stability error over five years shall not exceed 0.25°F cumulative. Direct connection of RTDs to digital controllers without transmitters is preferred. When RTDs are connected directly, lead resistance error shall be less than 0.25°F. The total error for a RTD circuit shall not exceed 0.5°F.
- D. Temperature Sensor Details
 - 1. Room Type: Provide the sensing element components within a decorative protective cover suitable for surrounding decor.
 - a. Provide room temperature sensors with: This needs to reference the ductless split spec, coordinate and integrate with the ductless split thermostat. Confirm type with Mitsubishi.

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- 1) Setpoint adjustment lever or knob.
- b. Provide a communication port or 802.11x wireless support for a portable operator interface like a notebook computer or PDA.
2. Duct Probe Type: Ensure the probe is long enough to properly sense the air stream temperature.
3. Duct Averaging Type: Continuous averaging sensors shall be one foot in length for each 4 square feet of duct cross-sectional area, and a minimum length of 6 ft.
4. Pipe Immersion Type: Provide minimum three-inch immersion. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel when used in steel piping, and brass when used in copper piping. Provide the sensor well with a heat-sensitive transfer agent between the sensor and the well interior.
5. Outside Air Type: Provide the sensing element on the building's north side with a protective weather shade that positions the sensor approximately 3 inches off the wall surface, does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain.
- E. Transmitters: Provide transmitters with 4 to 20 mA or 0 to 10 VDC linear output scaled to the sensed input. Transmitters shall be matched to the respective sensor, factory calibrated, and sealed. Size transmitters for an output near 50 percent of its full-scale range at normal operating conditions. The total transmitter error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 12 to 24 volts AC or DC. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter drift shall not exceed 0.03 °F a year.
- F. Relative Humidity Transmitters: Provide transmitters with an accuracy equal to plus or minus 3 percent from 0 to 90% scale, and less than one percent drift per year. Sensing elements shall be the polymer type. Vaisala Model HMD50U or equal.
- G. Current Transducers: Provide current transducers to monitor motor amperage, unless current switches are shown on design drawings or point tables.
- H. Input Switches
 1. Timed Local Overrides: Provide buttons or switches to override the DDC occupancy schedule programming for each major building zone during unoccupied periods, and to return HVAC equipment to the occupied mode. This requirement is waived for zones clearly intended for 24-hour continuous operation.
 2. Freeze Protection Thermostats: Provide special purpose thermostats with flexible capillary elements 20-feet minimum length for coil face areas up to 40-SF. Provide longer elements for larger coils at 1-foot of element for every 4-SF of coil face area or provide additional thermostats. Provide switch contacts rated for the respective motor starter's control circuit voltage. Include auxiliary contacts for the switch's status condition. A freezing condition at any 18-inch increment along the sensing element's length shall activate the switch. The thermostat shall be equipped with a manual push-

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button reset switch so that when tripped, the thermostat requires manual resetting before the HVAC equipment can restart.

2.7 OUTPUT HARDWARE

A. Electronic valve actuation shall be provided.

1. Manufactured, brand labeled or distributed by BELIMO, or approved equal.
2. Size for torque required for damper seal at load conditions.
3. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
4. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
5. Overload protected electronically throughout rotation.
6. Fail-Safe Operation: Mechanical, spring-return mechanism.
7. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 60 in.-lb. torque capacity shall have a manual crank.
8. Proportional Actuators shall be fully programmable through an EEPROM without the use of actuator mounted switches.
9. Proportional actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
10. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. All actuators shall provide a 2 to 10 VDC position feedback signal.
11. Temperature Rating: -22 to +122°F.
12. Housing: Minimum requirement NEMA type 2 mounted in any orientation.
13. Agency Listings: ISO 9001, cULus, CE or CSA
14. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.

B. Control Valves: Control valves shall be two-way or three-way type for two-position or modulating service as shown.

1. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - a. Two-way: 150% of total system (pump) head.
 - b. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
2. Water Valves: Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
 - a. Sizing Criteria:

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- 1) Two-position service: Line size.
 - 2) Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, which ever is greater.
- b. Application:
- 1) DOAS heating coils two-way modulating control, spring open 100%.
 - 2) Fintube radiation: Zone valves shall have brass bodies with female NPT or sweat ends and a stainless-steel stem. Normally open zone valve actuators shall on/off and shall be available in 24VAC or 120VAC. Zone valves shall have push button for quick removal of actuator. Zone valves shall have a leakage rate of 0.1% or lower.
- c. Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless-steel ball.
- d. Water valves shall fail normally open or closed, as specified.
- C. Output Switches: Control Relays; Field installed and DDC panel relays shall be double pole, double throw, UL864 listed, with contacts rated for the intended application, indicator light, and dust proof enclosure. The indicator light shall be lit when the coil is energized and off when coil is not energized. Relays shall be the socket type, plug into a fixed base, and replaceable without tools or removing wiring. Encapsulated "PAM" type relays may be used for terminal control applications.

2.8 STATUS SENSORS

- A. NEMA 250, Type 1 enclosure.

2.9 ELECTRICAL POWER AND DISTRIBUTION

- A. Transformers: Transformers shall conform to UL 506. For control power other than terminal level equipment, provide a fuse or circuit breaker on the secondary side of each transformer.
- B. Surge and Transient Protection
1. Provide each digital controller with surge and transient power protection. Surge and transient protection shall consist of the following devices, installed externally to the controllers.
 2. Power Line Surge Protection: Provide surge suppressors on the incoming power at each controller or grouped terminal controllers. Surge suppressors shall be rated in accordance with UL 1449, have a fault indicating light, and conform to the following:
 - a. The device shall be a transient voltage surge suppressor, hard-wire type individual equipment protector for 120 VAC/1 phase/2 wire plus ground.
 - b. The device shall react within 5 nanoseconds and automatically reset.
 - c. The voltage protection threshold, line to neutral, shall be no more than 211 volts.

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- d. The device shall have an independent secondary stage equal to or greater than the primary stage joule rating.
 - e. The primary suppression system components shall be pure silicon avalanche diodes.
 - f. The secondary suppression system components shall be silicon avalanche diodes or metal oxide varistors.
 - g. The device shall have an indication light to indicate the protection components are functioning.
 - h. All system functions of the transient suppression system shall be individually fused and not short circuit the AC power line at any time.
 - i. The device shall have an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.
 - j. The device shall comply with IEEE C62.41.1 and IEEE C62.41.2, Class "B" requirements and be tested according to IEEE C62.45.
 - k. The device shall be capable of operating between -20 °F and 122 °F.
- 3. Telephone and Communication Line Surge Protection: Provide surge and transient protection for DDC controllers and DDC network related devices connected to phone and network communication lines. The device shall provide continuous, non-interrupting protection, and shall automatically reset after safely eliminating transient surges. The protection shall react within 5 nanoseconds using only solid-state silicon avalanche technology. The device shall be installed at the distance recommended by its manufacturer.
- 4. Controller Input/Output Protection: Provide controller inputs and outputs with surge protection via optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.
- C. Wiring: Provide complete electrical wiring for the DDC System, coordinate line of demarcation with Division 26. Unless indicated otherwise, provide all normally visible or otherwise exposed wiring in conduit. Where conduit is required, control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall be in accordance with Division 26. Run all circuits over 100 volts in conduit, metallic tubing, covered metal raceways, or armored cable. Use plenum-rated cable for circuits under 100 volts in enclosed spaces. Examples of these spaces include HVAC plenums, within walls, attics, or above suspended ceilings.
- D. Power Wiring: The following requirements are for field-installed wiring:
 - 1. Wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.
 - 2. Wiring for 120 V circuits shall be insulated copper 14 AWG minimum and rated for 600 VAC service.
- E. Analog Signal Wiring: Field-installed analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded and have a 20 AWG drain wire. Each wire shall have insulation rated for 300 VAC service. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started. Verify that duct-, pipe-, and equipment-mounted devices and wiring are installed before proceeding with installation.
- C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work or others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be provided at the expense of this contractor.

3.2 INSTALLATION

- A. Provide software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation. Connect and configure equipment and software to achieve sequence of operation specified.
- B. Provide all components in accordance with the manufacturer's recommendations. Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.
- C. Provide equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- D. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. Contractor shall have work inspected by local and/or state authorities having jurisdiction over the work.
- F. Temperature Sensors: Provide temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate sensors according to manufacturer's instructions. Do not use sensors designed for one application in a different application.

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- G. Room Temperature Sensors: Verify location of thermostats and other exposed control sensors with plans and room details before installation. Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of the sensor 48" above the floor to meet ADA requirements.
 - 1. Provide guards on room temperature sensors as shown on the plans.
- H. Outside Air Temperature Sensors: Provide outside air temperature sensors in weatherproof enclosures on the north side of the building, away from exhaust hoods and other areas that may affect the reading. Provide a shield to shade the sensor from direct sunlight.
- I. Provide labels and nameplates to identify control components according to Section 23 05 00 "Common Work Results".
- J. Provide duct volume-control dampers according to Section 23 31 13 "Ductwork"

3.3 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes, and Division 26 of this specification. Where the requirements of this section differ from Division 26, the requirements of Division 26 shall take precedence.
- B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements. Low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.
- C. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended application.
- D. Do not install Class 2 wiring in raceways containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- E. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 10 ft intervals.
- F. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- G. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- H. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

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- I. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.
- J. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- K. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- L. Size of raceway and size and type of wire type shall be the responsibility of the contractor in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
- M. Include one pull string in each raceway in 1-inch or larger.
- N. Use color-coded conductors throughout with conductors of different colors.
- O. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- P. Conceal all raceways except within mechanical, electrical, or service rooms.
- Q. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- R. Adhere to this specification's Division 26 requirements where raceway crosses building expansion joints.
- S. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.
- T. The contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- U. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 3-feet in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
- V. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes. Ends not terminating in boxes shall have bushings installed.

3.4 COMMUNICATION WIRING

- A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- B. Do not install communication wiring in raceways and enclosures containing Class 1 or other Class 2 wiring.
- C. Maximum pulling, tension, and bend radius for the cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- D. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.
- E. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to manufacturer's instructions.
- F. All runs of communication wiring shall be unspliced length when that length is commercially available.

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- G. All communication wiring shall be labeled to indicate origination and destination data.
- H. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."
- I. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135.
- J. Fiber Optic Cable: Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post-installation residual cable tension shall be within cable manufacturer's specifications. All cabling and associated components shall be installed in accordance with manufacturers' instructions. Minimum cable andunjacketed fiber bend radii, as specified by cable manufacturer, shall be maintained.

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. Report results in writing.
 - 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.
 - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.

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5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

B. 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.

C. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.6 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-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 milliamper 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.

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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 and humidity 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 three visits to Project during other than normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Section 017900 "Demonstration and Training."
- B. Provide a qualified instructor (or instructors) with five years minimum field experience with the installation and programming of similar BACnet DDC systems. Orient training to the specific systems installed. Coordinate training times with the Owner. Training shall take place at the job site.
- C. This training shall last a minimum of four (4) hours and shall be conducted at the DDC system workstation, at a notebook computer connected to the DDC system in the field, and at other site locations as necessary. Upon completion of the Training, each trainee should fully understand the project's DDC system operation. The training session shall include the following:

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- D. Provide basic control system fundamentals training.
 - 1. This project's list of control system components
 - 2. This project's list of points and objects
 - 3. This project's device and network communication architecture
 - 4. This project's sequences of control, and:
 - 5. Alarm capabilities
 - 6. Trending capabilities
 - 7. Troubleshooting communication errors
 - 8. Troubleshooting hardware errors
- E. Provide additional project-specific training:
 - 1. A walk-through tour of the mechanical system and the installed DDC components (controllers, valves, dampers, surge protection, switches, thermostats, sensors, etc.)
 - 2. A discussion of the components and functions at each DDC panel
 - 3. Logging-in and navigating at each operator interface type.
 - 4. Using each operator interface to find, read, and write to specific controllers and objects.
 - 5. Modifying and downloading control program changes
 - 6. Modifying setpoints
 - 7. Creating, editing, and viewing trends
 - 8. Creating, editing, and viewing alarms
 - 9. Creating, editing, and viewing operating schedules and schedule objects
 - 10. Backing-up and restoring programming and data bases
 - 11. Modifying graphic text, backgrounds, dynamic data displays, and links to other graphics
 - 12. Creating new graphics and adding new dynamic data displays and links.
 - 13. Alarm and Event management
 - 14. Adding and removing network devices

3.8 TEST AND BALANCE SUPPORT

- A. The controls contractor shall coordinate with and provide on-site support to the test and balance (TAB) personnel This support shall include:
 - 1. On-site operation and manipulation of control systems during the testing and balancing.
 - 2. Control setpoint adjustments for balancing all relevant mechanical systems.
 - 3. Tuning control loops with setpoints and adjustments determined by TAB personnel.

3.9 CONTROLS SYSTEM OPERATOR'S MANUALS

- A. Provide three electronic and printed copies of a Controls System Operators Manual. The manual shall be specific to the project, written to actual project conditions, and provide a complete and concise depiction of the installed work. Provide information in detail to clearly explain all operation requirements for the control system.

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- B. Provide with each manual: CDs of the project's control system drawings, control programs, data bases, graphics, and all items listed below. Include gateway back-up data and configuration tools where applicable.
- C. Provide printed manuals in sturdy 3-ring binders with a title sheet on the outside of each binder indicating the project title, project location, contract number, and the controls contractor name, address, and telephone number. Each binder shall include a table of contents and tabbed dividers, with all material neatly organized. Manuals shall include the following:
 - 1. A copy of the as-built control system (shop) drawings set, with all items specified under the paragraph "Submittals." Indicate all field changes and modifications.
 - 2. A copy of the project's mechanical design drawings, including any official modifications and revisions.
 - 3. A copy of the project's approved Product Data submittals provided under the paragraph "Submittals."
 - 4. A copy of the project's approved Performance Verification Testing Plan and Report.
 - 5. A copy of the project's approved final TAB Report.
 - 6. Printouts of all control system programs, including controller setup pages if used. Include plain-English narratives of application programs, flowcharts, and source code.
 - 7. Printouts of all physical input and output object properties, including tuning values, alarm limits, calibration factors, and set points.
 - 8. A table entitled "AC Power Table" listing the electrical power source for each controller. Include the building electrical panel number, panel location, and circuit breaker number.
 - 9. The DDC manufacturer's hardware and software manuals in both print and CD format with printed project-specific labels. Include installation and technical manuals for all controller hardware, operator manuals for all controllers, programming manuals for all controllers, operator manuals for all workstation software, installation and technical manuals for the workstation and notebook, and programming manuals for the workstation and notebook software.
 - 10. A list of qualified control system service organizations for the work provided under this contract. Include their addresses and telephone numbers.
 - 11. A written statement entitled "Software Upgrades" stating software and firmware patches and updates will be provided upon request at no additional cost to the Owner for a minimum of two years from contract acceptance. Include a table of all DDC system software and firmware provided under this contract, listing the original release dates, version numbers, part numbers, and serial numbers.

3.10 CLEANING

- A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be required to match the

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adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

END OF SECTION 230900

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SECTION 230993 - SEQUENCE OF OPERATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section - Common Work Results
 - 2. Section 230900 – Direct Digital Control (DDC) System
 - 3. Other Sections – Equipment with built in DDC controllers.
 - 4. Division 23 Section - Testing, Adjusting, and Balancing
 - 5. Division 26
 - 6. Division 28

1.2 GENERAL

- A. Control sequences are intended to be performance based. Implementations that provide the same functional result using different underlying detailed logic will be acceptable. As noted, control sequences shall be in accordance with ASHRAE Guideline 36-2021.
- B. All points shown in the points list or described in the sequence shall be shown on the graphics.
- C. All setpoints including setpoints internal to control algorithms shall be adjustable from all BAS operator interfaces. All commands shall be overridable from all BAS operator interfaces. All control points shall be adjustable or overridable from the same graphic page that displays the points.
- D. All points required by the sequence of operation including, but not limited to, the points listed in the sequences of operation below, as well as all of the points' associated values, shall be connected to the BAS and available to the BAS operators on all operator workstations and all operator interface devices as part of a graphical display that depicts the mechanical system controlled.
- E. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent windup.
- F. When a control loop is enabled or reenabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a neutral value.
- G. A control loop in neutral shall correspond to a condition that applies the minimum control effect, i.e., valves/dampers closed, VFDs at minimum speed, etc.

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- H. The term “control loop” or “loop” is used generically for all control loops. These will typically be PID loops, but proportional plus integral plus derivative gains are not required on all loops. Unless specifically indicated otherwise, the guidelines in the following subsections shall be followed.
1. Use proportional only (P-only) loops for limiting loops (such as zone CO2 control loops, etc.). Limiting loops are used to prevent controlled variables from rising above or dropping below setpoint (depending on the application) by defining a fixed threshold at which the loop output reaches 100%. Limiting loops shall use proportional-only control to prevent integral windup from causing the controlled sensor to overshoot setpoint due to the sensor generally being far from setpoint.
 2. Do not use the derivative term on any loops unless field tuning is not possible without it. Use of the derivative term makes loop tuning difficult in practice. It can make loops unstable because it increases as the rate of change of the error increases, amplifying the error signal. It is used in industrial process controls and systems that have to react quickly but is rarely if ever needed in HVAC system.
- I. To avoid abrupt changes in equipment operation, the output of every control loop shall be capable of being limited by a user adjustable maximum rate of change, with a default of 25% per minute.
- J. All setpoints, timers, deadbands, PID gains, etc. listed in sequences shall be adjustable by the user with appropriate access level whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.
- K. The BAS contractor is responsible for utilizing the functional performance test procedures developed by the commissioning agent in accordance with the procedures defined for functional performance test procedures.
- L. Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user with appropriate access level (e.g., for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point, and the software point shall be used in all sequences. Exceptions shall be made for machine or life safety.
1. All hardware points, not just inputs, shall be capable of being overridden for purposes of testing and commissioning. For example, the commissioning agent shall be able to command damper positions, valve positions, fan speeds, etc. directly through BAS overrides.
 2. The requirement to equate hardware points to software points is necessary for systems that do not allow overriding real input points.
 3. The user interface shall allow the user to set an expiration period that automatically releases the override after the period has expired. The system shall also keep track of who initiates each override and when.
- M. Provide Sequenced starting of HVAC equipment at initial startup, whether or not specifically mentioned in each Sequence of Operation.

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- N. All setpoints shall be monitored and adjustable. Setpoints listed herein are approximate. It is the responsibility of the BAS contractor to calibrate the system and all setpoints to actual working conditions once the system is on line.
- O. BACnet
1. All controllers with BACnet cards shall be integrated into the DDC system via BACnet. Provide DDC programming to define input and output information available through the boiler manufacturer's integration data port.
 2. All hardwired points and any setpoints, timers, or other control elements that are specified to be adjustable (adj.) shall be mapped as BACnet objects and be available on the user interface to be adjusted.
- P. Trends shall be provided for all hardware I/O points and integrated points listed as having trending and for analog and binary data points mapped to the user interface. Interval trending with sample intervals of 10 minutes shall be provided on analog process variables (this includes both analog inputs and calculated process variables) and process outputs. Data shall be stored at the supervisory controller or in the field controller and uploaded to the DDC system server when archiving is desired. Consult with the Owner to determine which trends should be archived. Trending shall be in place for a minimum of 24 hours prior to functional testing by the commissioning provider. The BAS shall sample and store trend data and shall be able to archive data to the hard disk.
- Q. Variable Frequency Drives (VFD) Speed Points per ASHRAE Guideline 36-2021:
1. The speed AO sent to VFDs shall be configured such that 0% speed corresponds to 0 Hz, and 100% speed corresponds to maximum speed configured in the VFD.
 2. For each piece of equipment, the minimum speed shall be stored in a single software point; in the case of a hard-wired VFD interface, the minimum speed shall be the lowest speed command sent to the drive by the BAS. The active minimum speed parameter shall be read every 60 minutes via the drive's network interface. When a mismatch between the drive's active minimum speed and the minimum speed stored in the software point is detected, the minimum speed stored in the software point shall be written to the VFD via the network interface to restore the active minimum speed parameter to its default value and generate a Level 4 alarm.
 3. Minimum speed setpoints for VFD-driven equipment shall be determined in accordance with the testing, adjusting, and balancing (TAB) specifications.
- R. Point Types
1. AO = analog output
 2. DO = digital output (also, BO = binary output)
 3. AI = analog input
 4. DI = digital input (aka BI = Binary Input)

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1.3 ALARMS

- A. Provide alarms per ASHRAE Guideline 36, Paragraph 5.1.12: “Alarms”.
- B. Provide at least the following requirements in the specification for the BAS graphical user interface:
 - 1. All alarms shall include a time/date stamp using the standalone control module time and date.
 - 2. Each alarm can be configured in terms of level, latching (Requires Acknowledgment of a Return to
 - 3. Normal/Does Not Require Acknowledgment of a Return to Normal), entry delay, exit deadband, and post-suppression period.
 - 4. An operator shall be able to sort alarms based on level, time/date, and current status. . Alarms should be reported with the following information:
 - a. Date and time of the alarm
 - b. Level of the alarm
 - c. Description of the alarm
 - d. Equipment tags for the units in alarm.
 - e. Possible causes of the alarm if provided by the fault detection routines.
 - f. The source that serves the equipment in alarm, per ASHRAE Guideline 36, Paragraph 5.1.19 “Hierarchical Alarm Suppression”.
- C. As per ASHRAE Guideline 36, there shall be 4 levels of alarm:
 - 1. Level 1: Life-safety message
 - 2. Level 2: Critical equipment message
 - 3. Level 3: Urgent message
 - 4. Level 4: Normal message
- D. Alarms shall be reset during a power failure; the controls shall be programmed to ignore alarms that will occur upon loss of power. For example, a pump status alarm is not necessary, since it’s obvious that the pump will fail upon loss of power.
- E. Alarms associated with equipment that is disabled shall be inhibited.
- F. If an operating equipment has any fault condition, a Level 2 alarm shall be generated, and a response shall be triggered as defined in ASHRAE Guideline 36.

1.4 TRIM & RESPOND (T&R) SET-POINT RESET LOGIC

- A. Provide T&R logic per ASHRAE Guideline 36, Paragraph 5.1.14: “Trim & Respond Set-Point Reset Logic”.
- B. Trim & Respond logic shall reset the setpoint within the range minimum (SPmin) to maximum (SPmax) setpoint. When the associated device is OFF, the setpoint shall be SP0.

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- C. T&R logic resets a setpoint for pressure, temperature, or other variables. It reduces the setpoint at a fixed rate until a downstream zone is no longer satisfied and generates a request. When a sufficient number of requests are present, the setpoint is increased in response. The importance of each zone's requests can be adjusted to ensure that critical zones are always satisfied. When a sufficient number of requests no longer exist, the setpoint resumes decreasing at its fixed rate. A running total of the requests generated by each zone is kept identifying zones that are driving the reset logic.

1.5 EQUIPMENT STAGING AND ROTATION

- A. All parallel equipment shall be lead/lag or lead/standby rotated to maintain even wear.
- B. Provide per ASHRAE Guideline 36, Paragraph 5.1.15: "Equipment Staging and Rotation".
- C. Two runtime points shall be defined for each equipment:
 - 1. Lifetime Runtime: The cumulative runtime of the equipment since equipment start-up. This point shall not be readily resettable by operators. Lifetime Runtime shall be stored to a software point on the control system server so the recorded value is not lost due to controller reset, loss of power, programming file update, etc.
 - 2. Staging Runtime: An operator resettable runtime point that stores cumulative runtime since the last operator reset. Staging Runtime provides a resettable runtime counter, which allows for reset of the staging runtime hours used for lead/lag or lead/standby rotation between maintenance intervals or equipment replacement while maintaining a separate log of the Lifetime Runtime.
- D. Lead/lag equipment: Unless otherwise noted, identical parallel staged equipment (e.g., pumps) shall be lead/lag alternated when more than one is off or more than one is on so that the equipment with the most operating hours as determined by Staging Runtime is made the last stage equipment and the one with the least number of hours is made the lead stage equipment.
- E. A faulted equipment is any equipment commanded to run that is either not running or unable to perform its required duty. For fans& pumps, upon identification of a fault condition:
 - 1. The next commanded off equipment in the staging order, Equipment "B", shall be commanded on while alarming Equipment "A" remains commanded on.
 - 2. If Equipment "B" fails to prove status (i.e., it also goes into alarm), it shall remain commanded on and the preceding step shall be repeated until the quantity of equipment called for by the current stage has proven on, or there is no more available equipment.
 - 3. Set alarming equipment to the last positions in the lead/lag or lead/standby staging order sequenced reverse chronologically (i.e., the equipment that alarmed most recently is sent to last position).
 - 4. Staging order of non-alarming equipment shall follow the even wear logic. Equipment in alarm can only automatically move up on the staging order if another equipment goes into alarm.
 - 5. Equipment in alarm shall run if so called for by the lead/lag or lead/standby staging order and present stage.

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PART 2 - SEQUENCES

2.1 BASIS OF DESIGN

A. Design Setpoints.

Type of Area	Winter DB	Summer DB
Office	70°F	None
Corridor	70°F	None
Resident Room	70°F	75°F
Mechanical Spaces	55°F	78°F
Electrical Switchgear	55°F	95°F
Elevator Machine Room	55°F	95°F
Stairwells	55°F	100°F
Storage Rooms	60°F	None
Vestibules	60°F	85°F
	60°F	85°F

- B. Heating systems shall be equipped with controls configured to automatically restart and temporarily operate the system as required to maintain zone temperatures above an adjustable heating setpoint down to 55°F.
- C. Cooling systems shall be equipped with controls configured to automatically restart and temporarily operate the mechanical cooling system as required to maintain zone temperatures below an adjustable cooling setpoint up to 85°F or to prevent high space humidity levels.
- D. Outside Air (OA) Conditions
1. The controller shall monitor the OA temperature and humidity and calculate the OA enthalpy on a continual basis. These values shall be made available to the system at all times.
 2. Level 3 alarm shall be generated for Sensor Failure: Sensor reading indicates shorted or disconnected sensor. In the event of a sensor failure, an alternate OA conditions sensor shall be made available to the system without interruption in sensor readings.
 3. If an OA Temp Sensor cannot be read, a default value of 0°F shall be used.
 4. If an OA Humidity Sensor cannot be read, a default value of 50 % shall be used.

2.2 AUTOMATIC RESTART SEQUENCES

- A. Provide Sequenced starting of all equipment, whether or not specifically mentioned in each Sequence of Operation: At initial start-up; for automatic starting on emergency power after power blackout.
- B. The BAS contractor shall submit an automatic restart sequence of operation that prioritizes the loads to be restarted, in order of importance, when a changeover in power occurs, either from normal power to emergency power or from emergency power to normal power and when there is more than one (1) piece of mechanical equipment to start at the same time (e.g., at the

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beginning of a normally scheduled occupied cycle). The automatic restart sequence of operation shall also show the time delays between the startup of each piece of mechanical equipment.

- C. In addition, during emergency power mode, the BAS shall stagger HVAC loads to prevent the power demand from exceeding generator capacity.
 - 1. Heat Pumps shall be disabled in both heating and cooling mode Boilers and hot water distribution equipment shall provide heat for the facility.
 - 2. The heating coil DOAS heating coil shall modulate to maintain normal occupied discharge air temperature.
- D. Simultaneous starting of motors shall be prevented by a sequential start program in the DDC system. This program shall also provide sequential restart after power failure of motors that were running prior to power failure.
- E. Software time delay relays shall be provided in the DDC system to allow fan motors to cool down before restarting. Motors shall have both a minimum interval time (between consecutive starts) of 10 minutes and a minimum off time (between stop and start) of 3 minutes.
- F. Automatic restart of fans after a safety shutdown trip shall be software prohibited through the de-energization of the remote start/stop contact. Fan restart shall be manually initiated by the operator either locally or remotely through a computer workstation after resolving the cause for shutdown.
- G. Operator Workstation: Display the following data:
 - 1. Individual minimum interval time for each piece of mechanical equipment.
 - 2. Individual minimum off time for each piece of mechanical equipment.
 - 3. Individual motor horsepower or amps.
 - 4. Individual restart delay for each piece of mechanical equipment.

2.3 DEDICATED OUTDOOR AIR SYSTEM (DOAS)

- A. DOAS unit shall be enabled by the BAS
- B. Factory DDC controller provided by DOAS unit manufacturer, coordinate with Section 237433. The factory controller includes the following:
 - 1. Supply & exhaust fan control
 - 2. Supply air temperature control.
 - 3. Heating, modulating hot water.
 - 4. Cooling
 - 5. Dehumidification
 - 6. Energy Recovery Wheel
- C. Provide monitoring and alarm points as per the Points List.

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- D. Duct smoke detectors shall be by the DOAS unit manufacturer. Detector furnished and wired to the fire alarm system by Division 26. Activated when products of combustion are detected in air stream. Smoke detector shall signal an alarm and shut down the unit when products of combustion are detected in airstream.
- E. DOAS emergency stop circuits are hardwired circuits that, when tripped, immediately shut the entire unit down to prevent damage.
 - 1. Supply smoke detector, manual reset.
 - 2. Return smoke detector, manual reset.
 - 3. Freezestat, auto reset.
 - 4. Supply fan VFD safety circuit, manual reset
 - 5. Power Phase Monitor, auto reset.
- F. Hot Water Freeze Protection Pump: At outdoor air temperatures below 45°F (ADJ.), or on a call for heating, the coil freeze protection pump shall operate. Alarm shall enable if pump status indicates a failure and the unit shall be disabled.
- G. Monitor DOAS BACnet points:
 - 1. Discharge air temperature
 - 2. Return air temperature
 - 3. Return air %RH
 - 4. Freeze protection pump status
- H. Monitor DOAS BACnet alarm points:
 - 1. Unit fault
 - 2. Filter status – coil
 - 3. Filter status – energy wheel
 - 4. Condensate overflow
 - 5. Freezestat
 - 6. Phase monitor status
 - 7. Freeze protection pump status

2.4 DUCT SMOKE DAMPERS

- A. Smoke dampers provided in ducts are required to close by building code in the event their associated smoke detectors are in alarm.
- B. Smoke detectors: Zero flow type, furnished with smoke dampers, see Section 233113 “Metal Ducts”.
- C. For software interlocks of smoke dampers to the fan systems, the smoke dampers shall be commanded open and closed on fan status through the DDC smoke damper control output.
- D. Provide with safety circuit hardwire interlocks: if fan fails to start after an appropriate time delay (not longer than five minutes), smoke dampers shall close through the DDC smoke

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damper control output, the fan shall be latched OFF, and an alarm sent through the DDC system. A software reset point, and a momentary pushbutton located at the temperature control panel for the associated fan system shall be provided to reset the fan system. On fan system start-up, a time delay shall allow the dampers to open before the fan is started. All necessary software and hardware interlocks shall be provided to perform these functions.

- E. The smoke dampers shall be hardwire interlocked to the associated fire alarm control module to close whenever the fire alarm control module indicates an alarm to shut down the associated AHU.
- F. Alarms shall be provided for each smoke damper by the BAS contractor. The alarm shall be generated when the smoke damper is not in its commanded position after the appropriate time delay allowing for the smoke damper to actuate fully. Alarms shall be provided regardless of if the smoke damper command is from the DDC system or fire alarm system. Binary inputs to the DDC system from the fire alarm system devices commanding the AHU systems and associated dampers shall be provided for to allow for required alarms.
- G. Smoke dampers shall go into alarm whenever they close.

2.5 TERMINAL UNITS – COMMON REQUIREMENTS

- A. Each zone shall have separate occupied and unoccupied heating and cooling setpoints.
- B. The active setpoints shall be determined by the operating mode of the Zone Group. Zone scheduling groups, or Zone Groups, are sets of zones served by a single air handler that operate together for ease of scheduling and/or to ensure sufficient load to maintain stable operation in the upstream equipment.
 - 1. The set points shall be the occupied set points during occupied mode, warm-up mode, and cooldown mode.
 - 2. The set points shall be the unoccupied set points during unoccupied mode, setback mode, and setup mode.
- C. The software shall prevent the following:
 - 1. The heating setpoint from exceeding the cooling setpoint minus 1°F (i.e., the minimum difference between heating and cooling setpoints shall be 1°F).
 - 2. The unoccupied heating setpoint from exceeding the occupied heating setpoint.
 - 3. The unoccupied cooling setpoint from being less than the occupied cooling setpoint.
- D. The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.
 - 1. The adjustment shall be capable of being limited in software.
 - a. As a default, the active occupied cooling setpoint shall be limited between 73°F and 80°F.

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- b. As a default, the active occupied heating setpoint shall be limited between 65°F and 72°F.
2. The active heating and cooling setpoints shall be independently adjustable, respecting the limits and anti-overlap logic. If zone thermostat provides only a single set-point adjustment, then the adjustment shall move both the active heating and cooling setpoints upward or downward by the same amount.
3. The adjustment shall only affect occupied setpoints in Occupied Mode, Warmup Mode, and Cooldown Mode and shall have no impact on setpoints in all other modes.

E. Control Loops

1. Two separate control loops, the Cooling Loop, and the Heating Loop, shall operate to maintain space temperature at setpoint.
 - a. The Heating Loop shall be enabled whenever the space temperature is below the current zone heating set-point temperature and disabled when space temperature is above the current zone heating setpoint temperature, and the loop output is zero for 30 seconds. The loop may always remain active if provisions are made to minimize integral windup.
 - b. The Cooling Loop shall be enabled whenever the space temperature is above the current zone cooling set-point temperature and disabled when space temperature is below the current zone cooling set-point temperature and the loop output is zero for 30 seconds. The loop may always remain active if provisions are made to minimize integral windup.
2. The Cooling Loop shall maintain the space temperature at the active cooling setpoint. The output of the loop shall be a software point ranging from 0% (no cooling) to 100% (full cooling).
3. The Heating Loop shall maintain the space temperature at the active heating setpoint. The output of the loop shall be a software point ranging from 0% (no heating) to 100% (full heating).
4. Loops shall use proportional + integral logic or other technology with similar performance. Proportional-only control is not acceptable, although the integral gain shall be small relative to the proportional gain. P and I gains shall be adjustable by the operator.
5. See other sections for how the outputs from these loops are used.

F. Zone Temperature Alarms

1. High-temperature alarm
 - a. If the zone is 3°F above cooling setpoint for 10 minutes, generate a Level 4 alarm.
 - b. If the zone is 5°F above cooling setpoint for 10 minutes, generate a Level 3 alarm.
2. Low-temperature alarm
 - a. If the zone is 3°F below the heating setpoint for 10 minutes, generate a Level 4 alarm.

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- b. If the zone is 5°F below the heating setpoint for 10 minutes, generate a Level 3 alarm.
- 3. Suppress zone temperature alarms as follows:
 - a. After zone setpoint is changed.
 - b. While Zone Group is in Warmup Mode or Cooldown Mode.

2.6 TERMINAL UNITS – SPECIFIC REQUIREMENTS

A. Terminal Heating Units, 2-position valve controlled – Fintube, convectors:

- 1. Input Device: Electronic temperature sensor (for spaces with a heat pump in addition to fintube radiation, the heat pump shall provide first stage cooling and fintube shall provide second stage cooling, via integration with the heat pump manufacturer's controller.
- 2. Open/close valve to maintain temperature.

B. VRF/SPLIT HEAT PUMPS:

- 1. The Building Automation System (BAS) shall integrate to the Variable Refrigerant Flow (VRF) main controller to allow for system scheduling, monitoring, alarming, and setpoint adjustment. The VRF system shall be controlled via its manufacturer-provided controls as required to maintain space temperature setpoints. This includes, but is not limited to indoor unit fan control, compressor staging and modulation, condenser fan operation, and heat/cool mode changeover.
- 2. The BAS shall send occupied and unoccupied cooling/ heating setpoints to the VRF system.
- 3. Provide BAS interface to the VRF controller specified in Section 238130. The BACnet interface allows for a one-to-one connection between an indoor unit and the BAS. The interface allows the BAS to monitor and control the indoor unit through BACnet. VRF system points shall be mapped to the BAS. As a minimum:
 - a. Space temperature.
 - b. Heat or cool mode
 - c. Supply temperature.
 - d. Zone scheduling.
 - e. Filter status
 - f. Drain pan overflow.
 - g. Fault
 - h. Secondary heat status
- 4. For rooms with both a heat pump and finned tube supplemental heat, the VRF unit space temp sensor shall stage the finned tube radiation on continued drop in space temperature below setpoint with heat pump energized in heating mode.

END OF SECTION 230993

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SECTION 232113 – HYDRONIC HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results"
 - 2. Division 23 controls section for temperature-control valves and sensors.

1.2 SUMMARY

- A. This Section includes piping and specialties for hydronic HVAC piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping
 - 2. Hydronic specialties
 - 3. Chemical treatment.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Qualify soldering processes, procedures, and solderers for copper and copper alloy pipe and tube in accordance with ASTM B 828.
- C. Qualify brazing processes for copper and copper alloy pipe and tube according to ANSI/AWS C3.4.

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- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- E. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

1.6 COORDINATION

- A. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- B. Coordinate layout and installation of hydronic piping and suspension system components with other construction.
- C. Coordinate pipe sleeve installations and penetrations with other trades.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Balancing Valves:
 - a. Griswold Controls.
 - b. ITT Bell & Gossett
 - c. Taco, Inc.
 - d. Tour & Anderson
 - e. IMI Flow Design
 - f. Griswold Controls
 - g. Watts Industries Inc.
 - h. Caleffi
 - i. Nexus
 - 2. Hydronic Pressure-Reducing Valves:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Conbraco Industries, Inc.

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- d. ITT Bell & Gossett
 - e. Spence Engineering Company, Inc.
 - f. Caleffi
 - g. Watts Industries, Inc.
3. Safety Valves:
- a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Conbraco Industries, Inc.
 - d. ITT McDonnell & Miller.
 - e. Kunkle Valve Division.
 - f. Spence Engineering Company, Inc.
 - g. Caleffi
 - h. Watts Industries Inc.
4. Air Vents and Vacuum Breakers:
- a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. ITT Hoffman
 - d. Caleffi
 - e. Spirotherm
 - f. Spirax Sarco, Inc.

2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. DWV Copper Tubing: ASTM B 306, Type DWV.
- C. Fitting Standard: Copper fittings shall conform to ASME B16.18, ASME B16.22 or ASME B16.26.
- D. Press Fitting: Viega Pro Press - Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect) feature design (leakage path). Provide a smart connect feature to assure leakage of liquids and/or gases from inside the system past the sealing element of an un-pressed connection. The function of this feature shall be to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

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- E. Wrought-Copper Unions: ASME B16.22.
- F. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- G. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A-53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40 and 80, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 and larger: ASTM A-53, Type E (electric-resistance welded), Grade B, Schedule 40 and 80, black steel, plain ends.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- F. Wrought-Steel Fittings: ASTM A-234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings: Material Group: 1.1. End Connections: Butt-welding. Facings: Raised face.
- H. Mechanically formed copper or steel tee connections are not acceptable.
- I. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ANSI B16.11 may be used for drain, vent and gage connections.
- J. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- K. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 POLYPROPYLENE PIPING

- A. Pipe shall be Nupi Niron or Aquatherm.
- B. Pipe and fittings shall be covered by a factory warranty for 30 years to be free of defects in materials or manufacturing.

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- C. Pipe shall be Niron Clima Pipe manufactured from a PP-RCT resin meeting the short-term properties and long-term strength requirements of ASTM F 2389 and CSA B137.11. The pipe shall not contain rework or recycled materials. All pipe is made in an extrusion process and is pigmented as solid steel grey in color. The piping shall be extruded with a middle layer that has glass fiber content to restrict thermal expansion. All pipe complies with the rated pressure requirements of ASTM F 2389 and CSA B137.11. Pipe shall be Niron PP- RCT piping as manufactured by Nupi Americas of Houston, TX.
- D. Fittings shall be manufactured from a PP-RCT resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled. All fittings shall be as complying with NSF 14, ASTM F 2389 and CSA B137.11. Fittings shall be Niron PP-RCT piping as manufactured by Nupi Americas of Houston, TX.
- E. Fittings may be either socket fusion through nominal 5-inch, electrofusion style through 8 inch or butt fusion style in nominal 2 inch through 24-inch sizes. Electrofusion may also be performed in nominal sizes 10 inch through 24 inch by means of the use of electrofusion couplings.

2.6 PEX PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. PEX-a manufacturer system warranty shall cover tubing for a duration of 30 years from the date of installation.
 - 1. Uponor Wirsbo hePEX (Basis of Design)
 - 2. Rehau
 - 3. Watts Radiant
 - 4. Viega
- B. Manufacturer's Warranty for Hydronic Piping: Provide a 25 year warranty for PEX-a piping and ASTM F 1960 fittings. Performance Requirements: PEX-a piping and fittings shall meet the following pressure and temperature ratings:
 - 1. 200°F at 80 psi.
 - 2. 180°F at 100 psi.
 - 3. 73.4°F at 160 psi.
- C. Plastic Pipe and Fittings:
 - 1. PEX-a (Engle-method Crosslinked Polyethylene) Piping: Uponor Wirsbo hePEX, ASTM 876 with oxygen-diffusion barrier that meets DIN 4726.
 - 2. PEX-a Fittings, Elbows and Tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
 - 3. UNS No. C69300 Lead-free (LF) Brass.
 - 4. 20 percent glass-filled polysulfone as specified in ASTM D6394.
 - 5. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D6394.
 - 6. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D6394

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7. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D6394.
8. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".

D. Plastic-to-Metal Transition Fittings:

1. Manufacturer: Provide fittings from the same manufacturer of the piping.
2. Threaded Brass to PEX-a Transition: One-piece brass fitting with male or female threaded adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring. Typically used for PEX sizes 3 inch and below.
3. Brass Sweat to PEX-a Transition: One-piece brass fitting with sweat adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring. Typically used for PEX sizes 3 inch and below.
4. Dezincification-resistant (DZR) Brass to PEX-a Transition: Male NPT thread and PEX compression fitting. Editor: Typically used for PEX sizes 1 inch through 4 inch.

E. Plastic-to-Metal Transition Unions:

1. Manufacturer: Provide unions from the same manufacturer of the piping.
2. Threaded Brass to PEX-a Union: One-piece brass fitting with male or female threaded adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring. Typically used for PEX sizes 3 inch and below.
3. Brass Sweat to PEX-a Union: One-piece brass fitting with sweat adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring. Typically used for PEX sizes 3 inch and below.

2.7 HYDRONIC VALVES

A. Ball Valves

1. Soldered Ends 3" and Smaller: 150 psi WP and 600psi non-shock CWP, full-port cast bronze or forged brass two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Watts FBVS-3C series/B6081 series, Hammond 8511, Nibco S-585-70, Milwaukee BA150, Apollo 70-Series, approved or equal.
2. Comply with MSS SP-110.

B. Bronze Globe Valves, Class 125:

1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.

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C. Swing check valves:

1. Construct pressure containing parts of Valves as follows: Bronze Valves: 125 or 150 psi: ANSI/ASTM B 62; Iron Body Valves: ANSI/ASTM A-126, Grade B. Comply with the following standards for design, workmanship, material and testing: Bronze Valves: MSS SP – 80; Cast Iron Valves: MSS SP – 71.
2. Construct valves of pressure casting free of any impregnating materials. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
3. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond IB904, Nibco T-413Y, Stockham B320T, Milwaukee 509 or approved equal.
4. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond IB912, Nibco S-413-Y, Stockham B310T, Milwaukee 511 or approved equal.
5. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, horizontal swing, cast-iron disc: Hammond IR1124, Nibco F918-B, Stockham G931, Milwaukee F2974 or approved equal.

- D. ASME Safety Relief Valves: Bell & Gossett A-434D, or equal; diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV. The fluid shall not discharge into the spring chamber. The valve shall have a low blow-down differential. The valve seat and all moving parts exposed to the fluid shall be of non-ferrous material.

2.8 HOOKUPS AND BALANCING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Nexus (Basis of Design)
2. IMI Flow Design
3. HCI
4. Hays
5. Griswold
6. Victaulic
7. Taco
8. Bell & Gossett

- B. Minimum Requirements Per Coil Installation:

1. Manual Flow Control Valve (MFCV)
2. Y-strainer.
3. Temperature Control Valve (TCV) – see 230900.
4. Union connections at coil and TCV.
5. Air vent on return side.
6. Blowdown/drain valve on supply side.
7. Pressure/temperature test plugs across coil and TCV.
8. Full port, union end ball valves or butterfly valve for shutoff.

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C. Materials Of Construction:

1. Brass or stainless steel metals.
2. Teflon, EPDM or FKM seals.

D. Installation

1. Installation shall conform to basic piping methods specifications.
2. All components shall be isolated by shutoff valves.
3. Flexible hoses shall be installed at coil connections as shown in the plans or at the option of the mechanical contractor.
4. Union tailpieces may be used to reduce pipe sizes to match coil and TCV valve sizes.
5. Pressure/Temperature test plugs shall be installed across coil.
6. A Y-strainer or combination strainer and valve shall be installed on the supply side.
7. Unions shall be used to isolate the coil, AFCV and TCV.

E. Shutoff Valves shall be forged brass ball valves, Nexus Model UX:

1. A one-piece body rated at 250 psi WP, 325° F.
2. Interchangeable union ends with FKM O-ring seal (ground joint is not acceptable).
3. Multiple ¼” tapped ports for test plugs, vent, and/or drain.
4. Blowout-proof stem with dual KFM O-ring seals.
5. Hard chrome plated stainless steel ball with Teflon seats.

F. Manual Flow Control Valves shall be a combination of metering/balance type of forged brass construction, Nexus Model XB:

1. A modified venturi equipped with (2) pressure/temperature ports and an ID tag.
2. A combination shutoff and memory stop device-indicating degree of opening.
3. A rating of 250 WOG, 325°F.
4. An interchangeable union ends with FKM O-ring type seal.
5. Blowout proof stem with dual FKM O-ring seals.
6. Hard chrome plated stainless steel ball with Teflon seats.

G. Temperature Control Valves, ref. Section 230900 & 230993.

H. Combination Strainer/Ball Valves used for supply side shutoff and strainer requirements shall be forged brass construction, Nexus Model UY:

1. A minimum rating of 250 WOG, 325° F.
2. Interchangeable union end with FKM O-ring seal.
3. Multiple ¼” tapped ports for test plugs, vent, or other accessories.
4. Blowout proof stem with dual FKM O-ring seals.
5. Hard chrome plated stainless steel ball with Teflon seats.
6. A 20 mesh 304 stainless steel filter screen, accessible without affecting the valve piping.
7. A port in the filter cap for a blowdown/drain valve.

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- I. Y-Strainers shall be forged brass body, Nexus Model UYX:
 - 1. ¼” tapped accessory ports.
 - 2. A rating of 250 WOG, 325° F.
 - 3. A 20 mesh 304 stainless steel filter screen, removable without affecting the strainer piping.
 - 4. A port in the filter cap for a blowdown/drain valve.
- J. Blowdown/Drain Valves shall be forged brass ball valve construction, Nexus Model BD:
 - 1. A minimum rating of 250 WOG, 325° F.
 - 2. Blowout proof stem with dual FKM O-ring seals.
 - 3. Hard chrome plated brass ball with Teflon seats.
 - 4. A ¾” hose end and nylon / brass cap with retainer to protect threads.
- K. Unions (2” and smaller) shall be forged brass, Nexus Model UU:
 - 1. A minimum of 250 psi WP, 325° F.
 - 2. Multiple ¼” tapped ports for test plugs, vent and/or drain valves.
 - 3. FKM O-ring seal.
- L. Accessories to coil piping components shall conform to the following:
 - 1. Nexus PT Pressure/Temperature test plugs shall be rated for 1000 psi, 325° F, with brass body, Nordel check plugs, and sealed cap.
 - 2. Flexible hoses shall be designed for water, and fire retarding conform to ASTM codes E84-00, with stainless steel outer braid.
 - 3. Hoses (½” thru 1”), Nexus UFHF.
 - a. Shall have a Kevlar reinforced EPDM tube core, brass end fittings, and designed for a working pressure of 400 psi, 248°F.
 - b. Provide dual union or swivel end fittings.
 - 4. Hoses (1¼” thru 2”), Nexus UFHM:
 - a. Shall have Rayon reinforced EPDM tube core, brass end fittings, and designed for a working pressure of 300 psi, 248° F. The (2½”) hose shall have stainless steel outer braid and carbon steel Sch. 40 fittings, and designed for a working pressure of 400 psi, 70° F.
 - b. Provide least one union or swivel end fitting
 - 5. Nexus MV Manual air vents shall be of brass construction and rated at 250 psi, 450° F.
 - 6. Shaft extensions (2” and smaller) for insulated pipe shall be at least 2¼” tall and constructed of brass

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2.9 HYDRONIC SPECIALTIES

- A. Automatic Air Vent: Spirotherm Spirotop, or equal; maintenance-free, designed to vent automatically with float principle; solid-brass body and nonferrous internal parts; 150-psig working pressure; 270°F maximum temperature; NPS 1/2 inlet connection; 1/2" male thread at vent point for pressure-testing or remote venting of unwanted gases. The Spirotop has a unique "dry" vent design that helps prevent the system fluid from reaching the spring actuated Viton seat and seal assembly, which is the cause of most conventional air vent failures. Air vent shall be dry: release air, not water.
1. The unique valve mechanism is guaranteed not to leak and cannot be shut off.
 2. Specially constructed air chamber to protect the valve mechanism from dirt.
 3. Sufficient volume to handle pressure fluctuations.
 4. A reliable vacuum breaker for system draining.
 5. Leak and dirt resistant.
- B. Y-Pattern Strainers: Strainers shall be Y-type with removable basket. Body shall have cast-in arrows to indicate direction of flow. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI Type 304 corrosion-resistant steel. Provide fine-mesh start-up strainers. Strainers in sizes 3-inch and smaller shall have screwed ends; Hammond 3010, or approved equal. Body material shall be cast bronze conforming to ASTM B584-C84400. Strainer bodies fitted with screwed screen retainers shall have straight threads and shall be gasketed with nonferrous metal. Strainer screens shall have perforations not to exceed 1/32". In sizes 4 and larger, strainers shall have flanged ends; Hammond 3030, or approved equal. Body material shall be cast iron conforming to ASTM A126 Class B. Strainer bodies fitted with bolted-on screen retainers shall have offset blowdown holes. Strainer screens shall have perforations not to exceed 1/16" (4" size); 1/8" (5" size and larger).

2.10 WATER TREATMENT FOR CLOSED LOOP HYDRONIC SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Sentinel
 2. Anderson Chemical Company.
 3. Aqua-Chem, Inc.
 4. Barclay Water Management, Inc.
 5. General Electric Company; GE Water & Process Technologies.
 6. H-O-H Water Technology, Inc.
 7. Metro Group, Inc. (The); Metropolitan Refining Div.
 8. Nalco; an Ecolab company.
 9. Watcon, Inc.

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B. Performance Requirements

1. Provide water treatment for closed-loop hydronic systems.
2. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.
3. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
4. Closed hydronic systems, including shall have the following water qualities:
 - a. pH: Maintain a value within 8.2 to 9.5.
 - b. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 - c. Total Hardness : <150 ppm as CaCO_3 .
 - d. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
 - e. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 - f. TSS: Maintain a maximum value of 10 ppm.
 - g. Ammonia: Maintain a maximum value of 20 ppm.
 - h. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
 - i. Microbiological Limits:
 - 1) Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
 - 2) Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
 - 3) Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
 - 4) Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
 - 5) Iron Bacteria: Maintain a maximum value of zero organisms/mL.

- C. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 HYDRONIC PIPING APPLICATIONS – ABOVE GROUND

- A. Hot Water, NPS 3 and Smaller: Type L drawn-temper copper tubing with pressed or soldered joints; Schedule 40 steel pipe with threaded joints; polypropylene; PEX-a piping.

3.2 VALVE APPLICATIONS

- A. Hydronic Valve Applications: Shutoff Duty: Ball valves.
- B. Provide shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line.

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- C. Provide calibrated balancing valves in the return water line of terminal units, as indicated, and as required to facilitate system balancing.

3.3 HYDRONIC PIPING INSTALLATIONS

- A. Refer to Division 23 Section "Common Work Results" for installation of:
 - 1. Basic piping requirements.
 - 2. Joint construction requirements.
 - 3. Hanger, support, and anchor devices.
 - 4. Firestopping
 - 5. Sleeves and Escutcheons
 - 6. Dielectric fittings
 - 7. Valves
 - 8. Mechanical Identification
- B. Hydronic piping systems shall be provided to permit the system to be drained. Provide drains, consisting of a tee fitting, NPS 3/4 ball valve, and hose-end fitting with cap, at low points in piping system mains and elsewhere as required for system drainage.
- C. Provide piping at a uniform grade of 0.2 percent upward in direction of flow. Pipe size at connections to equipment shall be distribution main size, not connection size. Reduce pipe sizes using eccentric reducer fitting installed with level side up. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- D. Provide safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Provide safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements. Check the settings and operation of each safety valve, including valves furnished by heater manufacturer. Record settings.
- E. Swing Connections for Expansion: Connect risers and branch connections to mains with at least five pipe fittings, including tee in main. Connect mains and branch connections to terminal units with flexible hoses at least four pipe fittings, including tee in main.
- F. Terminal Equipment Connections
 - 1. Size for supply and return piping connections shall be same as for equipment connections.
 - 2. Provide control valves in accessible locations close to connected equipment.
 - 3. Arrange piping with offsets to allow for expansion, as well as terminal unit removal.

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3.4 HYDRONIC SPECIALTIES INSTALLATION

- A. Provide air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

3.5 CONTROL VALVE INSTALLATION

- A. Perform the following as directed by the BAS contractor:
 - 1. Provide modulating control valves with minimum of 10 pipe diameters straight pipe at inlet and 5 pipe diameters straight pipe at outlet.
 - 2. Installation of immersion wells and pressure tappings, along with associated shut-off cocks.
 - 3. Installation of flow switches.
 - 4. Setting of automatic control valves or other control devices.
- B. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
- C. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.

3.6 CHEMICAL TREATMENT

- A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the water characteristics described in Part 2.
- B. Provide bypass chemical feeders in each hydronic system.
 - 1. Provide in upright position with top of funnel not more than 48 inches above the floor.
 - 2. Provide feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
 - 3. Provide NPS 3/4 pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.
- C. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 6 feet per second, if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of

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risers. Provide temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the commissioning agent.

- D. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water. Circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 6 feet per second. Circulate each section for not less than four hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.
- E. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.
- F. Close and fill system as soon as possible after final flushing to minimize corrosion. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- G. Fill systems that glycol solutions to the concentrations indicated in the equipment schedules.
- H. ADD GLYCOL SPEC HERE? DOAS SCHEDULE HAS 30% PG

3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Provide blinds in flanged joints to isolate equipment.
 - 5. Provide safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

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2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

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SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division Section: "Common Work Results"

1.2 SUMMARY

- A. This Section includes hydronic pumps and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pump.
 - 1. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated.
 - 2. Indicate pump's operating point on curves.
 - 3. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.
- 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.

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

- A. Coordinate electrical power with Division 26.
- B. [Concrete Bases: Refer to Section 230500.]
- C. [Inertia Bases: Refer to Section 230548.]

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Taco
 - 2. Armstrong
 - 3. Bell & Gossett ITT
 - 4. PACO
 - 5. Grundfos
 - 6. Patterson
 - 7. Wilo

2.2 GENERAL PUMP REQUIREMENTS

- A. Pump Units: Factory assembled and tested.
- B. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be non-overloading over full range of pump performance curve. Comply with NEMA MG 1 requirements for thermally protected motors.

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- C. Motors Indicated to be premium efficiency and shall meet or exceed all NEMA Standards Publication MG1 requirements and comply with NEMA premium efficiency levels Class B temperature rise, Class F insulation.
- D. Motors used with VFD's: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Provide AEGIS® Shaft Grounding Ring (SGR) on either DE or NDE of motor to divert current away from the bearings and protect bearings in attached equipment.
 - 2. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

2.3 VARIABLE SPEED WET ROTOR CIRCULATOR PUMPS – GRUNDFOS MAGNA3

- A. Pump shall be a Grundfos Magna3 or approved equal; in-line wet rotor design. Oil lubricated pumps and shaft coupled pumps shall not be accepted. The pump shall be a standard product of a single pump manufacturer. The pump, motor, and variable speed drive shall be an integral product designed and built by the same manufacturer.
- B. The enclosure shall be marked "Enclosure Type 2."
- C. The pump shall be certified and listed by a Nationally Recognized Test Laboratory (NRTL) for U.S. and Canada to comply with UL778 and UL 60730-1A.
- D. Ratings
 - 1. Maximum Pressure: 175 PSIG
 - 2. Minimum Media Temperature: 14 °F
 - 3. Maximum Media Temperature: 230 °F
 - 4. Maximum Continuous Media Temperature: 203 °F
 - 5. Maximum Sound Pressure Level: 43dB(A)
 - 6. Voltage: 1x115V +/-10% or 1x208-230V +/-10% as required.
 - 7. Maximum Energy Efficiency Index: 0.20
- E. Pump Construction
 - 1. Pump housing: Cast Iron: EN-JGL-250 with Cataphoresis surface treatment
 - 2. Stainless Steel: 304 Stainless
 - 3. Impellers: Composite PES 30% GF
 - 4. Rotor Can: PPS reinforced with Carbon Fiber(Fortran MT9141L PPS-GF40)
 - 5. Rotor Cladding: 316 Stainless Steel
 - 6. Stator Housing: Aluminum
 - 7. Shaft: 316L Stainless Steel
 - 8. Thrust Bearing: Axial: Carbon Graphite, Radial: ceramic Alumina Hilox 961
 - 9. O-Rings: EPDM
 - 10. Bearing Plate: 304 Stainless Steel

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11. Neck Ring: 304 Stainless Steel
12. Control Box: Polycarbonate

F. Motor

1. Motor shall be 4-pole permanent-magnet (PM motor) and tested with the pump as one unit by the same manufacturer. Conventional asynchronous squirrel-cage motors shall not be acceptable.
2. Each motor shall be of the integrated Variable Speed Drive design consisting of a motor and a Variable Frequency Drive (VFD) built and tested as one unit by the same manufacturer.
3. The stator housing shall be made of pressure die cast aluminum.
4. The motor shall be cooled by the pumped fluid
5. The power electronics shall be cooled to the ambient air.
6. The Motor shall be self-ventilating.
7. Minimum insulation class for the motor shall be Class F.
8. The integrated VFD control shall utilize an energy optimization algorithm to minimize energy consumption by reducing the factory-set setpoint and adjust to system characteristics. This shall be accomplished without the need of any external sensors or input.

G. The pump shall have the following control mode and operating modes:

1. **AUTOADAPT** – During operation, the pump automatically reduces the factory-set setpoint and adjusts it to the actual system characteristic. Manual setting of the setpoint is not possible.
2. **FLOWLIMIT** - It shall be possible for the user to select a maximum flow that the pump shall not exceed in order to eliminate the need for additional throttling valves. The pump shall operate per selected control mode but will limit speed to not exceed the user specified flow limit
3. **FLOWADAPT** – The pump shall operate in the AUTOADAPT control mode with FLOWLIMIT enabled.
4. **Proportional Pressure** – The head delivered shall be reduced from a manual setpoint linearly in accordance with decrease in flow demand in the system
5. **Constant Pressure** – A manual set, constant head is maintained, irrespective of flow up to the maximum speed of the pump.
6. **Constant Curve** – The pump runs as an uncontrolled pump by the means of a set of pump curves. The pump curve adjustable between maximum and minimum from the control panel or through a wireless remote control.
7. **Constant Temperature** – the pump shall adjust speed to maintain a constant media temperature in the flow pipe in which the pump is installed.
8. **Constant Differential Temperature** - the pump shall adjust speed to maintain a constant temperature drop between the flow pipe in which the pump is installed, and a user installed temperature sensor.
9. **Alternating Operation** – Two single head pumps or two heads of a dual head pump shall communicate wirelessly to one another. In alternating operation, only one pump shall operate at a time. The operation shall alternate based on time or energy to ensure even run time of both pumps. If a pump stops due to fault the other pump shall take over automatically.

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10. Back-Up Operation – Two single head pumps or two heads of a dual head pump shall communicate wirelessly to one another. In Back-Up operation one pump shall operate continuously. If the duty pumps stops due to fault the back-up pump shall take over automatically.
11. Cascade Operation - Two single head pumps or two heads of a dual head pump shall communicate wirelessly to one another. Two pumps shall operate together in constant pressure control. The pump controller shall determine when to operate a single pump or both pumps to meet demands. While both pumps operate, they shall run at the same speed.

H. Interface and Communication

1. The pump shall have an integrated operator interface consisting of:
 - a. Minimum 2.4” (measured diagonally) color TFT display
 - b. 7 push buttons for navigation of menu
 - c. Push Buttons must be able to operate at minimum 25,000 times
 - d. Push Buttons must be isolated from the main supply by reinforced insulation according to UL60730
 - e. LEDs to signal pump status for quick indication
2. The pump shall have a sensor integrated directly into the pump housing with 4 lines consisting of Ground, Supply, and two signals for Differential Pressure and Media Temperature.
 - a. Sensor Supply shall be 4.8V DC +/- 2% at 20mA referenced to Ground. The supply must be able to withstand a permanent short circuit.
 - b. The electrical values for the signal shall be 4.8V DC +/-2% referenced to ground.
3. The pump module shall have one analog input configurable for either 4-20mA or 0-10VDC input signal configurable for external Temperature or Pressure sensor, or Setpoint influence. Sensor input shall have three wires for Ground, Supply, and Signal. The Supply for external analog input shall be 24V DC +/-10% at 22mA reference to Ground. The supply must be able to withstand a permanent short circuit. Connection can be made to a screw terminal capable of wire sizes up to AWG16.
4. The pump shall have 3 Digital Inputs galvanically isolated from the main supply by a reinforced insulation according to UL60730.
 - a. Start/Stop –Used to start or start the pump. The pump shall be enabled when connected to common ground by an external potential free short circuit. An open circuit to this input shall disable the pump. Connection can be made to a screw terminal capable of wire sizes up to AWG16.
 - b. Minimum – used to force the pump to run at minimum load (curve). When connected to common ground by an external potential free short circuit the pump must run at minimum load. Connection can be made to a screw terminal capable of wire sizes up to AWG16.
 - c. Maximum - used to force the pump to run at maximum load (curve). When connected to common ground by an external potential free short circuit the pump must run at maximum load. Connection can be made to a screw terminal capable of wire sizes up to AWG16.

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5. The pump module shall have two Output Relays. Each relay shall be configurable for Alarm, Reading, or Operating indication. Each relay must have three screw terminals see above. Output relays contacts shall be rated for maximum 250VAC at 2A and minimum 5VDC at 20mA. Each must have galvanic isolation from the internal supply by reinforced insulation according to UL60730.
6. Shall be capable of accepting an optional add-on module for integration into Building Management Systems:
 - a. LonWorks
 - b. BACnet
 - c. Modbus
7. The pump module shall have wireless connectivity for two pumps to communicate with one another or for the pump to communicate to a mobile device with additional hardware.
 - a. Communication range shall at minimum within 30ft of the pump without walls or barriers.
 - b. Two identical pumps shall be capable of wireless communication with one another to operate as a two-pump system in:
 - 1) Duty/Standby
 - 2) Alternating Mode, pumps alternate operation every 24 hours
 - 3) Cascade operation with both pumps running simultaneously in constant differential pressure mode.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations for compliance with requirements for installation. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Pumps and equipment shall be provided per manufacturer's recommendations and according to the standards of the Hydraulics Institute.
- B. Provide pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- C. Pipe connections to pumps shall be made in such a manner so as not to exert any stress on pump housings. If necessary to meet this requirement, provide additional pipe supports and flex connectors.

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- D. Reduction from line size to pump connection size shall be made with eccentric reducers attached to the pump with tops flat to allow continuity of flow and to avoid air pockets.
- E. Provide connector/expansion joints at the pump suction and discharge as indicated.
- F. Pumps shall **NOT** be run dry to check rotation.
- G. In-line Pumps: Provide in-line pumps with continuous-thread hanger rods and elastomeric hangers of size required to support weight of in-line pumps.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Provide piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Provide valves that are the same size as piping connected to pumps.
- D. Provide suction and discharge pipe sizes equal to or greater than diameter of pump nozzles. Provide fittings and specialties as detailed on the plans.
- E. Provide a single gage with three-input selector valve; locate at pump suction and discharge tapings, also strainer.
- F. Connect wiring and provide grounding in accordance with Division 26. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1. Install control and electrical power wiring to field-mounted control devices.

3.4 COMMISSIONING

- A. Verify that pumps are installed and connected according to the Contract Documents. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents. Complete installation and startup-checks according to manufacturer's written instructions.
- B. Provide start-up of the pumping systems. This start-up shall include verification of proper installation, system initiation, adjustment, and fine tuning. Start-up shall not be considered complete until the sequence of operation, including all alarms, has been sufficiently demonstrated to the Owner or Owner's designated representative. This jobsite visit shall occur only after all hook-ups, tie-ins, and terminations have been completed and signed-off on the manufacturer's start-up request form.
- C. Check piping connections for tightness.
- D. Clean strainers on suction piping.

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- E. Perform the following startup checks for each pump before starting:
 - 1. Verify bearing lubrication.
 - 2. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - 3. Verify that pump is rotating in the correct direction.
- F. Prime pump by opening suction valves and closing drains, prepare pump for operation. Start motor. Open discharge valve slowly.
- G. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
 - 2. Review data in maintenance manuals.

END OF SECTION 232123

SECTION 233113 - DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 8 for Access Doors
 - 2. Division 23 Section "Common Work Results"
 - 3. Division 23 Section "Diffusers, Registers, and Grilles."
 - 4. Division 23 Control Section
 - 5. Division 23 Section "Testing, Adjusting, and Balancing".

1.2 SUMMARY

- A. This Section includes ductwork and accessories.

1.3 SYSTEM DESCRIPTION

- A. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide necessary fittings and offsets. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions, which may be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
- B. The contractor must comply with the enclosed specification in its entirety. If on inspections, the engineer finds changes have been made without prior written approval, the contractor will make the applicable changes to comply with this specification, at the contractor's expense.
- C. At the discretion of the engineer, sheet metal gauges, and reinforcing may be randomly checked to verify duct construction is in compliance.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

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- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1. Exception: Sheet metal surfaces and fasteners.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

- B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Fittings.
4. Reinforcement and spacing.
5. Seam and joint construction.
6. Penetrations through fire-rated and other partitions.
7. Equipment installation based on equipment being used on Project.
8. Hangers and supports, including methods for duct and building attachment.

- C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

- D. Ductwork Specialties Product Data; provide for the following:

1. Sealant
2. Duct-mounted access doors and panels.
3. Flexible ducts.
4. Manual-volume dampers: Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval.
5. Life Safety dampers: Provide complete submittal information (including installation instructions) and the manufacturer's certification of compliance with these specifications for approval prior to bidding. Contractor shall include damper manufacturer's Installation Instructions as part of the submittal. These instructions shall describe the applicable requirements for damper sleeve thickness, retaining angles, and methods of attachment, duct-to-sleeve connections, preparation of wall or floor openings, and all other requirements to provide an installation equivalent to that tested by the damper manufacturer during the UL Standard 555 qualification procedures. Contractor shall detail any proposed installations that deviate from these manufacturer's instructions and explain the needed deviations.

1.6 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling – examples: lighting fixtures, sprinklers, etc.
 - 7. Areas of building where coordination drawings are required:
 - a. Duct risers and horizontal ducts within 30 feet of risers.
 - b. All ductwork 24” wide and larger.
 - c. Congested areas
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- C. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.8 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. National Fire Protection Association (NFPA): 90A: Standard for the Installation of Air Conditioning and Ventilating Systems
- D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): 3rd Edition: 2005 HVAC Duct Construction Standards, Metal and Flexible

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and fire stopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Deliver, store and handle materials according to manufacturer's written recommendations.
- C. All ductwork, equipment, and fittings delivered and stored on the job site must be capped to prevent the entry of moisture, construction dust or other debris.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M. Galvanized Coating Designation: G60 or G90 as indicated. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A-36/A-36M, steel plates, shapes, and bars; black and galvanized.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of un-braced panel area, unless ducts are lined. All large ducts must be braced as required to prevent drumming.

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- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA.
 - 1. Fig. 2-3 Rectangular Elbows: Type RE2 square throat with vanes, Type RE1 radius (1.5W minimum), or Type RE5 dual radius. Square throat is not allowed.
 - 2. Vane support in elbows: Fig 2-4. Turning vanes shall be double wall turning vanes fabricated from the same material as the duct. Mounting rails shall have friction insert tabs that align the vanes automatically. Tab spacing shall be as specified in Figure 2-3 of SMACNA. Rail systems with non-standard tab spacing shall not be accepted. Due to tensile loading, vanes shall be capable of supporting 250 pounds when secured according to the manufacturer's instructions.
 - 3. Fig. 2-5 Rectangular Divided Flow Branches: Type 1, Type 2, Type 4A, or 4B.
 - 4. Fig. 2-6 Branch Connections: 45-degree entry, 45-degree lead-in, bell-mouth or spin-in (single diffuser supply only).
 - 5. Fig. 2-7 Offsets and Transitions. Use gradual offsets as shown, 90-degree offsets shall be avoided.

2.3 ROUND DUCT FABRICATION

- A. Fabricate supply ducts of galvanized steel according to SMACNA.
- B. Longitudinal Seams: Select seam types and fabricate according to SMACNA Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA.
 - 1. Exposed Round Ducts: Shall be Spiral Seam (RL-1 seam) at 2-inch wg construction.
 - 2. Concealed Round Ducts: Shall be longitudinal Grooved Seam Flat lock (RL-5 seam) at 2-inch wg construction.
 - 3. Snap lock seams shall not be used for this project.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA.

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Outdoor Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

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- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A-603. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
- G. Supports For Roof Mounted Items:
 - 1. Equipment rails shall be galvanized steel, minimum 18-gauge, with integral baseplate, continuous welded corner seams, factory installed 2x4 treated wood nailer, 18-gauge galvanized steel counter flashing cap with screws, built-in cant-strip; minimum height 11 inches. Provide raised cant strip to start at the upper surface of the insulation.
 - 2. Roof Duct Supports: Portable Pipe Hanger Model number PPH-D - Enclosed style.
 - a. Engineered, portable system specifically designed for installation without the need for roof penetrations or flashings, and without causing damage to the roofing membrane.
 - b. Hot dip galvanize in accordance with ASTM A 123 after fabrication.
 - c. Factory fabricated to support exact duct sizes and equipment to be installed.
 - d. Provide SS or galvanized clamps, bolts, nuts, washers, and other devices as required for a complete system.

2.5 SEALANT MATERIALS

- A. Joint Sealant/Mastic: Shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall prevent the entry of water, air and moisture into the duct system. Sealer shall be UL 723 listed; UL 181A-M or 181B-M listed; and meet NFPA 90A requirements. Pressure sensitive tape shall not be used as a sealing mechanism.
 - 1. Maximum 5 flame spread and 0 smoke-developed (ASTM E-84 Tunnel Test).
 - 2. Generally, provide liquid sealant for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger.
 - 3. Resistance to mold, mildew and water: Excellent
 - 4. Color: Gray
 - 5. Duct sealant/mastic shall meet requirements for LEED. ITW TACC Miracle Kingco water-based sealants, or approved equal.
- B. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- C. Round Duct Joint O-Ring Seals: Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch w.g. and shall be rated for 10-inch w.g. static-pressure class, positive or negative. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 FITTINGS

- A. Tees, Laterals, and Conical Tees: Use 45 degree; fabricate to comply with SMACNA with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- C. Elbows: Diameters 3 through 8 inches shall be two-section die stamped; all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.

2.7 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. McGill Air Flow LLC.
 - 4. Nailor Industries Inc.
 - 5. Durodyne
 - 6. Cesco
 - 7. Buckley
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door: Double wall, rated for up to 4.5" static pressure. Door panel filled with 1" fiberglass insulation; ¾ lb. density. Hinges and Latches: 1-by-1-inch continuous piano hinge and cam latches. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs.
 - 3. Provide 1/8" thick neoprene gaskets.
 - 4. Locks: Access doors less than 12 sq. inches: One cam lock. Doors over 12 sq. inches shall have two locks.

2.8 FLEXIBLE CONNECTORS

- A. Provide for all air moving equipment. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with NFPA 90A. Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts. Duro-Dyne, Ductmate, Hardcast, or approved equal.
- B. Outdoor Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber or hypalon, white color; weatherproof coating resistant to the sun's ultraviolet rays and ozone

environment. Minimum Weight: 24 oz. /sq. yd. Tensile Strength: 530 lbf/inch in the warp, and 440 lbf/inch in the filling.

2.9 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 0 or 1. Flame Spread: Less than 25; Smoke Developed: Less than 50.
- B. All products shall be certified by Greenguard Environmental Institute; independent testing of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Greenguard provides independent, third-party certification of IAQ performance. Certification is based upon criteria used by EPA, OSHA and WHO.
- C. Rated Positive Pressure: 10" w.g. per UL-181. Maximum negative pressure: $\frac{3}{4}$ ".
- D. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing glass-fiber insulation around a continuous inner liner.
 - 1. R6 insulation, Basis of Design: Atco #86
 - 2. Reinforcement: Steel-wire helix encapsulated in inner liner.
 - 3. Jacket (inner and outer): Polyethylene film.
- E. Exhaust/Return Flexible Ducts, not insulated: Atco#50 Factory-fabricated, round duct. Reinforcement: Triple lamination of tough metallized polyester, aluminum foil and polyester encapsulates a steel wire helix. Rated for $\frac{3}{4}$ " w.g. negative pressure.
- F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.
- G. Hangers shall be band type, 1" wide minimum.

2.10 MANUAL-VOLUME DAMPERS

- A. Manual balancing dampers meeting the following specifications shall be furnished and installed on all branch ducts and where shown on plans. Testing and ratings to be in accordance with AMCA Standard 500-D.
- B. Single-Blade Rectangular Dampers shall consist of: an 18 ga. galvanized steel frame with 3-1/2 in. depth; blades fabricated from 20 ga. galvanized steel; integral 1/2 in. diameter axles. Damper suitable for pressures to 1.0 in. wg, velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBD-10.
- C. Multi-Blade Rectangular Dampers shall consist of: a 16 ga. galvanized steel hat channel frame with 5 in. depth; triple V type blades fabricated from 16 ga. galvanized steel; 1/2 in. dia. plated steel axles; external (out of the airstream) blade-to-blade linkage. Damper suitable for pressures to 4.0 in. w.g. (996 Pa), velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBD15.

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- D. Round dampers shall consist of: a 20 ga. galvanized steel frame with 6 in. depth; blades fabricated from 20 ga. galvanized steel; 3/8 in. square plated steel axles turning in acetal bearings. Damper suitable for pressures to 1.0 in. wg, velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBDR50.

2.11 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.
 - 2. Cesco Products
 - 3. Greenheck Fan Corporation.
 - 4. Metalaire, Inc.
 - 5. Nailor Industries Inc.
 - 6. Prefco
 - 7. NCA
 - 8. Ruskin Company.
- B. Type: Static; rated and labeled according to UL 555S by an NRTL.
- C. Fire Rating: 1-1/2 hours.
- D. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory-provided.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- I. Heat-Responsive Device: Provide replaceable fusible links with a temperature approximately 50°F above the maximum temperature that would normally be encountered within the system, but not less than 165°F.

2.12 SMOKE DAMPERS AND FIRE/SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.
 - 2. Cesco Products
 - 3. Greenheck Fan Corporation.

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4. METALAIRE, Inc.
5. Nailor Industries Inc.
6. Prefco
7. Ruskin Company.

B. Dampers shall have a:

1. UL555S leakage rating of Leakage Class I.
2. 555S elevated temperature rating of 350°F.
3. Minimum UL 555S differential pressure rating of 4 in. w.g.
4. Minimum UL 555S velocity rating of 2000 fpm

C. Linkage shall be concealed in jamb.

D. Mounting Sleeve: Factory-installed, 0.039-inch thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

E. Smoke Detector: No flow smoke detector shall be rated for air velocities 0 – 3000 fpm; low profile photoelectric smoke detector listed to UL 268A specifically for use in no flow or low flow air handling systems.

F. Fire/Smoke Dampers: Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

G. Damper Actuator - Electric:

1. UL 873, plenum rated.
2. Designed to operate in smoke-control systems complying with UL 555S requirements.
3. Two-position with fail-safe spring return.
4. Actuator to be externally factory mounted and provided with single-point wiring connection.

H. Provide breakaway connection, sleeve, and other components as per manufacturers recommendations for a code compliant installation.

I. Accessories:

1. Auxiliary switch for position indication.
2. Test and reset switches, remote mounted.
3. Provide a momentary test switch to enable easy maintenance and inspection by allowing the dampers to be tested and cycled by one person right at the damper location by simply holding the test switch down.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Provide volume dampers at branch ducts to RGD's. If volume dampers are inadvertently not shown, contractor shall provide, the intent is to provide volume dampers at branches.**

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- B. Provide ducts and accessories according to SMACNA unless otherwise indicated.
- C. Construct and install each duct system for the specific duct pressure classification indicated.
- D. Properly seam, brace, stiffen, support and render ducts mechanically airtight. Adjust ducts to suit job conditions. Dimensions may be changed as approved, if cross sectional area is maintained.
- E. Provide ducts in lengths not less than 12 feet, unless interrupted by fittings. Provide ducts with fewest possible joints.
- F. Provide fabricated fittings for changes in directions, changes in size and shape, and connections.
- G. Provide couplings tight to duct wall surface with a minimum of projections into duct.
- H. Provide ductwork to allow maximum headroom. Provide ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Provide ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Provide ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- K. Coordinate layout with suspended ceiling, lighting layouts, and similar finished work.
- L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Exterior ductwork shall have a pitch of at least 3 degrees on the top, to allow water runoff, prevent ice buildup.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Hangers Exposed to View: Threaded rod and angle or channel supports.
- C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system. Seal duct joints to prevent dirt marks.
- D. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

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- F. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 MATERIALS

- A. Hangers, accessories, and dampers shall be same material as parent duct.
- B. Ducts shall be G60 galvanized steel.

3.4 DUCT CLASSIFICATIONS AND SEALING

- A. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
 - 1. Supply Ducts: 2-inch w.g.
 - 2. Return Ducts: 2-inch w.g, negative pressure.
 - 3. Exhaust Ducts: 2-inch w.g, negative pressure.
- B. Seam And Joint Sealing:
 - 1. Ductwork and plenums with pressure class ratings shall be constructed to Seal Class A. Openings for rotating shafts shall be sealed with bushings or other devices that seal off air leakage.
 - 2. Pressure-sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory, and the tape is used in accordance with that certification.
 - 3. Connections shall be sealed, including but not limited to spin-ins, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required.
 - 4. Spiral lock seams need not be sealed.
 - 5. Seal externally insulated ducts before insulation installation.

3.5 DUCT PENETRATIONS

- A. Fire or Smoke Rated Penetrations not requiring a fire and/or smoke damper: Where ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and fire dampers are not required, the opening in the construction around the duct shall be provided in accordance with the UL listing of the penetration. Provide firestopping per Section 230500.
- B. Fire or Smoke Rated Penetrations: Provide fire and/or smoke damper.
- C. Non-Fire-Rated Exposed Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.
- D. Non-Fire-Rated Concealed Penetrations: Provide insulation infill and acoustical sealant around gaps. Tightly seal to prevent sound transmission. Neatly finish.

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- E. Mechanical room floor penetrations: Provide 4-inch high concrete curbs or other sealing method to prevent leakage from mechanical room into floor penetration.
- F. Roof penetrations by ducts shall use counter-flashed curbs.
- G. Flexible air ducts or connectors shall not pass through any wall, floor, or ceiling.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA Chapter 5, "Hangers and Supports."
- B. Building Attachments: Comply with SMACNA Chapter 5, "Hangers and Supports". Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
- C. Hanger Spacing: Comply with SMACNA Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- E. Provide upper attachments to structures. Select and size upper attachments with pull-out, tension,

3.7 FLEXIBLE DUCT

- A. Provide in accordance with manufacturer's and SMACNA recommendations.
- B. Flexible ducts shall be supported at manufacturer's recommended intervals, but at no greater distance than 5 feet. Maximum permissible sag is ½" per foot of spacing between supports.
- C. Provide duct fully extended; do not install in the compressed state or use excess lengths.
- D. Avoid bending ducts across sharp corners or incidental contact with metal fixtures, pipes, conduits, or hot equipment.
- E. Bends shall be made with not less than 1 duct diameter centerline radius. Ducts shall extend a few inches beyond the end of a sheet metal connection before bending.
- F. Hanger or saddle material in contact with the duct shall be at least 1" wide.
- G. Provide at least 2 duct diameters of straight duct at the entrance to register, grilles, and diffusers.

3.8 DUCT ACCESSORIES INSTALLATION

- A. Provide duct accessories according to applicable details shown in SMACNA.
- B. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards
- C. Each register, grille, or diffuser shall have a means of air flow adjustment. Provide volume damper in branch duct if not furnished with the RGD.
- D. Adjust operable devices for proper action.
- E. Manual dampers shall be visible outside the insulation and marked with a 12" orange ribbon.
- F. Locate each duct smoke detector in a serviceable location, in accordance with its listing.
- G. Perform the following as directed by the controls contractor: Installation of control devices. Access doors where indicated and as required.
- H. Provide duct access panels for access components that require servicing.
 - 1. Provide duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining per equipment manufacturers' requirements.
 - 2. Provide access panels on side of duct where adequate clearance is available.
 - 3. Locate panel upstream and/or downstream as recommended by manufacturer.
 - 4. Locations:
 - a. Adjacent to and close enough to life safety dampers, to reset or reinstall fusible links.
 - b. Control devices requiring inspection.
 - c. Elsewhere as indicated or required by duct accessory manufacturer
 - 5. Inspect locations of access doors and verify that purpose of access door can be performed.
- I. Fire Damper and fire/smoke damper Installation.
 - 1. Examine areas to receive dampers. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization of dampers. Do not proceed with installation until unsatisfactory conditions are corrected
 - 2. Provide dampers in accordance with manufacturer's UL Installation Instructions, labeling, and NFPA 90A at locations indicated on the drawings. Any damper installation that is not in accordance with the manufacturer's UL Installation Instructions must be approved prior to installation.
 - 3. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or plenums required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.
 - 4. Provide dampers square and free from racking.
 - 5. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.

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6. Do not compress or stretch the damper frame into the duct or opening.
 7. Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Provide support mullions as reinforcement between assemblies as required.
 8. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.
 9. Provide access door, properly located for serving.
 10. Tests and Inspections: Operate dampers to verify full range of movement and verify that proper heat-response device is installed.
 11. Provide concealed signage per International Mechanical Code.
- J. Fire Damper Maintenance: Re-commission the existing fire dampers in accordance with manufacturer's recommendations. As a minimum, the following shall be performed.
1. If cleaning is necessary, use mild detergents or solvents.
 2. If frame is 'racked' causing blades to bind on jamb seals, adjust frame such that it is square and plumb
 3. Fusible links shall be removed.
 4. Operate to verify that they close fully.
 5. Latch shall be checked.
 6. Lubricate axle bearings, jackshaft bearings, jamb seals, and other moving parts. Do not use oil-based lubricants or any other lubricants that attract contaminants such as dust.
 7. Replace fusible link.
- K. Smoke Damper Installation: The contractor shall coordinate smoke and smoke/fire damper installation, wiring, and checkout to ensure that these dampers function properly and that they respond to the proper fire alarm system general, zone, and/or detector trips. The contractor shall immediately report any discrepancies to the engineer no less than two weeks prior to inspection by the code authority having jurisdiction.
1. Fire/Smoke damper: Provide access door that is sized, and located for servicing damper.

3.9 PROTECTION

- A. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
1. The HVAC system and ductwork shall be provided with protective coverings. The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire duct from the points where the air enters the system to the points where the air is discharged from the system.
 2. The duct system shall be free of construction debris.
 3. The working area shall be clean, dry and the ductwork protected from dust.
 4. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.
- B. Upon completion of installation duct systems and before HVAC system start-up, visually inspect the ductwork proper installation

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- C. Cover supply openings with filter media prior to system start-up to catch any loose material that may remain inside the ductwork. Turn the HVAC system on and allow it to run until steady state operation is reached. Remove the temporary filter media from supply openings and, along with it, any loose material blown downstream and caught by the filter media.

3.10 DUCT CLEANING

- A. Ducts shall be kept clean. If the contractor fails to maintain cleanliness, duct cleaning will be required, using duct cleaning methodology as indicated in NADCA ACR.

END OF SECTION 233113

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SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results"
 - 2. Division 23 Section "Ductwork"
 - 3. Division 23 Section "Testing, Adjusting, and Balancing"

1.2 SUMMARY

- A. This Section includes diffusers, registers (combination grille & damper), and grilles.

1.3 SUBMITTALS

- A. Each manufacturer shall check noise level ratings for registers and diffusers to ensure that the sizes selected will not produce noise to exceed 30 db, "A" scale, measured at occupant level; notify Owner's representative of problems prior to shop drawing submittal.
- B. Pressure drop, airflow and noise criteria selection are based on design equipment. Manufacturers not submitting design makes must provide written certification in front of submittal that equipment submitted has been checked against and performs equal to the design make.
- C. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
 - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- D. Coordinate locations with reflected ceiling plans and wall elevations as applicable.
- E. Coordinate mounting frame with associated mounting surface.

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1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A.
- B. Sound pressure levels shall be determined by using AHRI Standard 885-2008 "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Outlets".
- C. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 2 - PRODUCTS

2.1 GENERAL

- A. Diffusers, registers, and grilles are scheduled on Drawings.
- B. Border and mounting type shall match the mounting surface. Coordinate with mounting conditions.
- C. Material shall match the specified ductwork. Coordinate with Section 233113 "Ductwork".
- D. Provide with a White Powder Coat finish, unless noted otherwise.
- E. Grille blade orientation: Vertical rectangle (wall grille with height longer than width): The blades shall run parallel to the short dimension of the grille. Horizontal rectangle: The blades shall run parallel to the long dimension of the grille.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Price
 - 2. Titus
 - 3. MetalAire
 - 4. Anemostat
 - 5. Nailor

2.3 RETURN OR EXHAUST

- A. Return/Exhaust Register, 45-degree deflection
 - 1. Material: aluminum (MetalAire V4002R)
 - 2. Provide integral volume control damper. Material shall match the register material. The damper shall be operable from the register face

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3. Grilles shall be 45-degree deflection fixed louver type with blades spaced 0.666" on center.
4. Factory painted, and humidity testing under ASTM D1735- 92 and passed with a test duration of 500 hours. It has also passed a 250-hour water soak test under ASTM D870-92.
 - a. Grilles installed on the third and fourth floor shall be SW 6244 Naval (coordinate with architect for final color).
 - b. Grilles installed on the second floor shall be white.

2.4 SUPPLY

A. Double-deflection Supply Register

1. Material: aluminum (MetalAire V4004-AF)
2. Registers shall be double deflection type with two sets of fully adjustable deflection aerodynamically shaped deflector blades spaced 0.666" on center.
3. The integral volume control damper shall be of the opposed blade type. Material shall match the register material. The damper shall be operable from the register face.
4. Deflector blades shall be individually adjustable.
5. Units shall be provided with screw holes on the face for surface mounting.
6. Blades shall pivot in friction mounting retainers.
7. Factory painted, and humidity testing under ASTM D1735- 92 and passed with a test duration of 500 hours. It has also passed a 250-hour water soak test under ASTM D870-92.
 - a. Grilles installed on the third and fourth floor shall be SW 6244 Naval (coordinate with architect for final color).
 - b. Grilles installed on the second floor shall be white.

B. Modular Louvered Face Diffusers

1. Material: steel (MetalAire 5500)
2. Air pattern shall be 1-way, 2-way, 3-way, or 4-way as scheduled.
3. Outer frame assembly, which facilitates mounting.
4. Integral collar that allows connection to the square or rectangular duct. Provide a square to round adaptor as scheduled.
5. Inner core assembly consisting of fixed louvers capable of producing the airflow discharge pattern as indicated on the project plans and shall be fully removable from the installed diffuser frame for access to any dampers or other ductwork components located in or near the diffuser neck.
6. The inner core assemblies shall be identically constructed so that directional core assemblies providing different airflow discharge patterns may be interchanged between frames if the frame duct connections are the same size.
7. The diffuser shall be supplied with a set of pattern deflectors to allow field adjustment of the air pattern from horizontal to vertical airflow.

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8. The diffuser shall be supplied with an aperture style volume flow damper. The damper shall be manually adjustable from the diffuser face.
9. Grilles installed on the third and fourth floor shall be SW 6244 Naval (coordinate with architect for final color).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Provide diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- C. Drawings indicate general arrangement of ducts, fittings, and accessories. Make final locations where indicated, as much as practicable.
 1. For units installed in lay-in ceiling panels, locate units in the center of the panel.
 2. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- D. Provide diffusers, registers, and grilles with airtight connection to ducts.
- E. Provide 18" minimum of vertical straight ductwork at the entrance to ceiling diffusers.
- F. Plenum boxes on grilles/registers shall be 8" minimum height.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.
- B. Adjustable outlets: adjust pattern for draft-free air distribution.

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3.3 CLEANING

- A. Protect unit interiors from moisture, construction debris and dust, and other foreign materials.
- B. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

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SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes factory-packaged dedicated outside air systems (DOAS).

1.3 ACTION SUBMITTALS

- A. Product Data: For each dedicated outdoor-air unit.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include unit dimensions and weight.
 - 4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
 - 5. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.
 - b. Certified fan-sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
 - 6. Include certified coil-performance ratings with system operating conditions indicated.
 - 7. Include filters with performance characteristics.
 - 8. Include heat exchangers with performance characteristics.
 - 9. Include dampers, including housings, linkages, and operators.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For dedicated outdoor-air units to include in emergency, operation, and maintenance manuals.

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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. Filters: One set for each unit.

1.6 SOURCE QUALITY CONTROL

- A. AHRI 920: Manufacturer to certify that performance ratings are in accordance with AHRI 920 if AHRI 920 certification program is not in place. Provide AHRI 920 certification if AHRI 920 certification program is in place.
- B. AHRI 260 or AMCA 311 Sound Performance Rating Certification: Test, rate, and label unit fan sound ratings in accordance with AHRI 260 or AMCA 311.
- C. Fan Aerodynamic Performance Rating: Test and rate fan performance for airflow, pressure, power, air density, rotation speed, and efficiency.
 - 1. Fan Aerodynamic Performance Rating: Test and rate fan performance in accordance with AMCA 210.
 - 2. AMCA Fan Aerodynamic Certification Rating: Test, rate, and label, in accordance with AMCA 211.
- D. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.
- E. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.
- F. Damper Leakage and Air Performance:
 - 1. Damper Rating: Test and rate dampers for leakage and air performance in accordance with AMCA 510.
 - 2. AMCA Damper Certification: Test, rate, and label in accordance with AMCA 511.
- G. Water Coils: Factory tested to 300 psig in accordance with AHRI 410 and ASHRAE 33.
- H. Refrigerant Coils: Factory tested to minimum 300 psig internal pressure and to minimum 300 psig internal pressure while under water, in accordance with AHRI 410 and ASHRAE 33.

1.7 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an "NRTL" (nationally recognized testing laboratory) and marked for intended location and application.

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- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of units and components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE 15 and ASHRAE 34 Compliance: For refrigeration system safety.
- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. ASHRAE 84 Compliance: Comply with capacity ratings for energy-recovery equipment.

1.8 WARRANTY

- A. Warranty: Manufacturer agrees to replace components of dedicated outdoor-air units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Dedicated Outdoor-Air-Handling Units: Eighteen months from ship date.
 - 2. Warranty Period for Compressors: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Greenheck
 - 2. Trane (Basis of Design-Trane Model OAU)
 - 3. Modine
 - 4. Reznor
 - 5. Daikin
 - 6. Addison

2.2 GENERAL UNIT DESCRIPTION

- A. Units furnished and installed shall be packaged OA (OA) units as scheduled on contract documents and described in these specifications. Units shall be designed for dehumidification, cooling and heating of 100% OA. For dehumidification and cooling modes, the evaporator temperature shall be monitored, reported at unit controller. Compressor controls shall modulate capacity to maintain evaporator leaving set point. Hot Gas Bypass shall not be used to control compressor capacity. Compressor Hot Gas Reheat (HGRH) shall be factory installed. To prevent rehydration of evaporator condensate the reheat coil face shall be located a minimum of 6" downstream from the leaving face of the evaporator coil. Heating system shall include

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modulating controls. Compressor on-off only or primary heating on-off only controls shall not be acceptable control strategies.

- B. Units shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
- C. Unit discharge airflow configuration shall be horizontal discharge through side of unit.

2.3 CABINET

- A. Cabinet panels: 2” double-wall foamed panel with thermal break construction throughout the indoor section of unit to provide nonporous, cleanable interior surfaces. All interior seams exposed to airflow shall be sealed.
- B. Insulation: 2” polyisocyanurate or 2” polyurethane injected foam metal encapsulated with no exposed edges. Initial R value of 6.6 per inch of thickness.
- C. Cabinet base shall be double wall construction designed to prevent trapping or ponding of water within the unit base. Cabinet base pan shall be insulated with 2” thick polyisocyanurate foam. Foam insulation shall be fully enclosed with galvanized steel insulation cover.
- D. The unit is supported on steel dunnage, insulation shall be applied to underside of unit base.
- E. Cabinet Base Rails: Side and end base rails shall include openings for forklift and tie-down access. To protect unit base from fork damage side rails shall include removable heavy gauge fork pockets.
- F. Shipping anchors attach to and/or through unit base rails. Straps over unit shall not be used to secure unit for shipping.
- G. Cabinet material interior and base rails: shall be G-90 zinc-coated galvanized steel. Material gauge shall be a minimum of 14-gauge for base rails, 16-gauge for structural members and 20-gauge for access doors and cabinet panels.
- H. Exterior Corrosion Protection: Exterior cabinet panels shall be a base coat of G-90 galvanized steel with both exterior and interior surfaces cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit’s surface shall comply with ASTM B117 salt spray testing at a minimum of 672-hour duration.
- I. Cabinet construction shall provide hinged panels providing easy access for all parts requiring routine service.
- J. Cabinet top cover shall be one piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.
- K. Hinged Access Panels: Water- and air-tight hinged access panels shall provide access to all areas requiring routine service including air filters, heating section, electrical and control cabinet sections, ERV, and power exhaust fan section, supply air fan section, evaporator and

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reheat coil sections. Insulated doors shall be constructed to allow the hinges to be reversed in the field.

- L. Hold-open devices shall be factory installed on all hinged front access doors. Chains shall not be used as hold-open devices.
- M. Latches with locking hasps or tool operated closure devices shall be factory installed on all hinged access panels.
- N. Drain Pan material shall be Type 304 Stainless steel drain and constructed to sloped in two directions to ensure positive drainage with corners exposed to standing water and drain fittings welded liquid tight to prevent leaks. Pan shall have a minimum depth of 2". Base of drain pan shall be insulated with 1" thick foam insulation.
- O. Cooling coil section: Cabinet shall have an interior liner constructed of Type 304 stainless steel with sealed seams.
- P. Filters: Provide a full complement of pleated media air filters.
 - 1. Evaporator filters shall be 2" deep MERV 13.
 - 2. Exhaust air, upstream of the heat recovery coil: MERV 8.

2.4 FANS AND MOTORS

- A. Indoor fans shall be high efficiency backward curved impeller.
- B. Indoor fans shall be direct drive with premium efficiency motors, statically and dynamically balanced, draw through.
- C. Outdoor fans shall be direct drive with premium efficiency motors, statically and dynamically balanced, draw through in the vertical discharge position.
- D. Provide shafts constructed of solid hot rolled steel, ground and polished, with keyway, and protectively coated with lubricating oil.
- E. Indoor Blower Motor: Direct Drive w/VFD.
- F. Powered Exhaust: Direct Drive w/VFD & Gravity Damper.

2.5 DAMPERS

- A. Unit shall include a motor operated OAOA damper constructed of galvanized steel.
- B. Damper blades shall be air foil design with rubber edge seals designed not to exceed a 4 CFM/SQ FT leakage rate exceeding ASHRAE 90.1 damper leakage requirements. Airfoil design Class 1A rated dampers are optional.

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- C. Damper actuator shall be factory mounted and wired sealed spring return and either two-position or fully modulating.
- D. Dampers air velocity shall not exceed 2000 fpm.

2.6 DEHUMIDIFICATION/COOLING

A. Compressors

- 1. All units shall have direct-drive, scroll type compressors.
- 2. Digital Scroll Compressor: Provide for both circuits.
- 3. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
- 4. Internal overloads shall be provided with the scroll compressors.
- 5. Each compressor shall have a crankcase heater to minimize the amount of liquid refrigerant present in the oil sump during off cycles.
- 6. Each compressor shall be mounted on rubber vibration isolators, to reduce the transmission of noise.
- 7. Provide each unit with 2 hermetically sealed refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, liquid line charging port, suction and liquid line pressure ports, sight glass, and thermal expansion valve.
- 8. Provide each circuit with automatic reset high and low pressure and high temperature switches for safety control.

B. Coils

- 1. Evaporator, Condenser and HGRH coils shall be constructed with copper tubes mechanically bonded to configured aluminum plate fins.
- 2. Casings to be constructed with 18- or 16-gauge G90 galvanized steel or 16- or 14-gauge 304 L stainless steel.
- 3. Copper tube shall be C12200, ASTM B75, that is 050 light annealed tubing, with a minimum grain size of 0.015 to 0.035 mm. Tensile strength shall be a minimum of 34KSI, with a yield strength of 9-13KSI.
- 4. Aluminum fin shall be of the Series 1100, ASTM B209, with an H112 Temper.
- 5. Coils shall be factory leak tested in accordance ANSI/ASHRAE 15-1992 at a minimum pressure of 500 PSIG.
- 6. The condenser coil shall have a fin designed for ease of cleaning.
- 7. Evaporator coil shall include (six / four) rows of cooling interlaced for superior sensible and latent cooling with a maximum of 12 FPI for ease of cleaning.
- 8. Reheat coil shall be fully integrated into the supply airstream and be capable of delivering design supply air temperature.
- 9. To prevent re-hydration of condensate from evaporator coil, the evaporator coil face and the HGRH coil face shall be separated by a minimum of six inches.
- 10. Coil Coating: Coil will have a flexible epoxy polymer e-coat uniformly applied to all coil surface areas with no material bridging between fins. The coating process will ensure complete coil encapsulation and a uniform dry film thickness from 0.6 – 1.2 mills on all surface areas including fin edges and meet 5b rating cross hatched adhesion per ASTM B3359- 93. Corrosion durability will be confirmed through testing with no less than

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5,000 hours salt spray resistance per ASTM B117-90 using scribed aluminum test school coupons. The coil coating will meet the following test standards:

- a. MIL-C-46168 Chemical Agent Resistance – DS2, HCL Gas.
- b. CIDA-A-52474-A (GSA).
- c. MIL-STD810F, Method 509.4 (Sand and Dust).
- d. MIL-P-53084 (ME)-TACOM Approval.
- e. MIL-DTL-12468 Decontamination Agent (STB).
- f. DPG (Dugway Proving Grounds) Soil & Water Exposure Tests.
- g. GM9540P-97 Accelerated Corrosion Test (120 cycles).
- h. ASTM B117-G85 Modified Salt Spray (Fog) Testing-2,000 hours (tested by ARL for Lockheed Martin).

11. The unit(s) must comply per above - spray coatings not acceptable.
12. Condenser coil hail guards shall be factory installed.

C. Condenser Section

1. Outdoor Fans: Shall be direct drive vertical discharge design with low-noise corrosion resistant glass reinforced polypropylene props, powder coated wire discharge guards and electro-plated motor mounting brackets.
2. Fans shall be statically and dynamically balanced.
3. Provide variable speed head pressure control.

D. Compressor Capacity Control: Electronic Control: Compressor output capacity shall be controlled by the Main Control Module (refer to unit control and sequence sections of this specification).

2.7 ELECTRICAL RATINGS AND CONNECTIONS

1. All high voltage power components such as fuses, switches and contactors shall include a service personnel protection barrier or shall be a listed as touch-safe design.
2. Field wiring access to be provided thru unit base into isolated enclosure with removable cover.
3. Power wiring to be single point connection.
4. Wiring internal to the unit shall be colored and numbered for identification.
5. Unit shall be factory wired to field wiring terminal block mounted in isolated enclosure.
6. Provide a factory wired fused disconnect switch.
7. Unit SCCR rating shall be a minimum of 65kA.
8. Factory wired Voltage/Phase monitor shall be included as standard. In the event of any of the following, the units will be shut down and a fault code will be stored in the monitor for the most recent 25 faults. Upon correction of the fault condition the unit will reset and restart automatically.
 - a. Phase Unbalance Protection: Factory set 2% with a maximum adjustment of 3% in the field.
 - b. Over/Under/Brown Out Voltage Protection: +/-10% of nameplate voltage.
 - c. Phase Loss/Reversal.

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9. Factory shall mount and wire a 120-volt convenience outlet. Field wiring of convenience outlet not acceptable.
10. All low voltage field wiring connections shall be made at factory installed low voltage terminal strip.

2.8 UNIT CONTROLS

- A. Unit Controls: Trane UC600 - Discharge Air Control w/BACNET w/Display.
- B. Main Control Module (MCM) shall be a microprocessor-based controller with resident control logic. Controller program logic shall include:
 1. Include single program with field selectable.
 2. Discharge Air control with unit conditioning modes enabled based on OAOA conditions and controlled to maintain discharge air setpoints.
 3. Controller shall be integrated with BAS via Bacnet MS/TP.
- C. MCM shall:
 1. Prevent simultaneous operation of any conditioning modes.
 2. Accept separate setpoints for Occupied and Unoccupied states.
 3. Call for Dehumidification based on dew point setpoints. When no call for Dehumidification is present MCM shall control calls for Cooling, Heating and Economizer modes based on sensible or enthalpy temperature setpoints. MCM shall have an onboard clock and scheduling function for occupancy.
 4. Include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
 5. Enable HGRH dehumidification and cooling modes and control modulation to maintain (discharge air temperature / space temperature).
 - a. Unit shall include minimum discharge air control.
- D. System Sensors shall include:
 1. Factory installed and wired OAOA Temperature, OAOA Humidity and Evaporator Leaving Air Temperature and factory furnished, field installed Discharge Air Temperature.
 2. Units shall include exhaust air leaving temperature sensor.
- E. System controls shall include:
 1. Anti-cycle timing.
 2. Minimum compressor run/off-times.
 3. Air Flow Monitoring: IFM Piezo Ring and PE Piezo Ring/Tap.
 4. Smoke Detectors: supply & return, shall be factory installed and wired.
 5. Provide a refrigerant detection system consisting of one or more refrigerant detection sensors. When the system detects a refrigerant leak, the following mitigation actions will

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be initiated. Once refrigerant is no longer detected, mitigation will continue for 5 minutes. The 5-minute timer operation is performed by the sensor.

- a. If a leak is detected in the airstream, energize the supply fans to deliver a required minimum amount of circulation airflow for dilution of refrigerant.
 - b. If a leak is detected in the controls cabinet, the supply fan will be de-energized and mechanical ventilation in the controls cabinet will be energized.
 - c. Disable heater operation.
 - d. Disable compressor operation.
6. Building or unit smoke detection systems will override the refrigerant detection system operation and will shut the unit down.

2.9 OA SECTION ENERGY RECOVERY (ERV)

A. Composite Energy Recovery Wheel

1. General Specifications:

- a. The energy recovery cassette shall incorporate a rotary wheel in an insulated cassette frame complete with removable energy transfer media, seals, drive motor and drive belt.
- b. Energy recovery wheel performance shall be AHRI 1060 certified and bear the AHRI certified label. Components that are independently tested or “rated in accordance with” shall not be acceptable. Manufacturer membership in AHRI is not an acceptable substitute. Certified components must be listed as active in the AHRI Directory. (www.ahridirectory.org)
- c. The energy recovery cassette shall be an Underwriters Laboratory UR recognized component for fire and electrical safety and bear the UR symbol. Recognized components shall be listed in the UL directory. (<http://database.ul.com>)
- d. The energy recovery cassette shall comply with NFPA 90A by virtue of UL standard 1812 and UL900 fire test for determination of flammability and smoke density.
- e. The energy recovery cassette shall carry a 5-Year standard warranty on the entire cassette assembly (excluding the motor) from the date of shipment. Motors shall carry the manufacturer’s standard 18-month warranty from the date of manufacture.

2. Cassette Frame and Wheel Construction:

- a. Cassette frame and structural components shall be constructed of G90 galvanized steel for corrosion resistance.
- b. Wheel structure shall consist of a welded hub, spoke and continuous rolled rim assembly of stainless steel, and shall be self-supporting without energy transfer segments present.
- c. Wheel structure shall be connected to the shaft by means of taper lock bushings.

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- d. Wheel bearings shall be permanently sealed and selected for a minimum 30-year L-10 life of 400,000 hours. Bearings requiring external grease fittings or periodic maintenance are not acceptable.
 - e. Standard cassettes may be affixed within the cabinet in any orientation without the need for factory modification.
- 3. Energy Transfer Media:
 - a. Energy transfer media shall be constructed of a durable synthetic lightweight polymer.
 - b. Media shall be wound continuously with one flat and one structural layer in an ideal parallel plate geometry. Airflow across heat exchanger surface shall remain laminar.
 - c. Energy transfer media shall not exceed 3" in depth.
 - d. Energy transfer media shall be suitable for use in corrosive, marine or coastal environments without the need for additional coatings.
- 4. Coatings and Desiccant:
 - a. Desiccant shall be either silica gel or molecular sieve and permanently bonded to the energy transfer media without the use of binders or adhesives, which may degrade desiccant performance. Desiccants not permanently bonded are not acceptable due to potential delamination or erosion of the desiccant from the energy transfer media.
 - b. Desiccant shall be non-migrating, nor shall it dissolve or deliquesce in the presence of water or high humidity.
 - c. Energy transfer media shall be capable of repeated washing without significant degradation of the desiccant bond as documented by an independent third party.
 - d. Removable Energy Transfer Segments.
 - e. Wheels 25" in diameter and greater shall be provided with removable energy transfer segments.
 - f. Segments shall be removable without the use of tools to facilitate maintenance and cleaning.
- 5. Seals:
 - a. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set.
 - b. Seals shall be non-contact nylon pile brush seal orientated in a labyrinth style configuration.
 - c. Diameter Seals shall be fully adjustable and easily accessible.
 - d. Perimeter seals shall be permanently mounted to the wheel rim and not require adjustment. Seals that mount to the frame are not acceptable.
- 6. Drive System:
 - a. The wheel drive motor shall be an Underwriters Laboratory Recognized Component and shall be mounted in the cassette frame and supplied with a service connector or junction box.

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- b. Three phase motors shall be suitable for use in both standard and inverter rated applications.
 - c. Wheels 52" and smaller shall use a urethane stretch belt for wheel rim drive without the need for external tensioners.
 - d. Wheels 58" and larger shall use a urethane non-stretch belt with integral cord and constant tensioner.
 - e. Wheel drive system shall not require periodic adjustment.
- 7. Maintenance:
 - a. Energy recovery segments shall be cleanable outside of the cabinet with detergent or alkaline coil cleaner and water.
 - b. Energy transfer segments shall be capable of submersion in a cleaning solution. Submersion shall be capable of restoring latent performance to within AHRI certified performance limits.
- 8. Purge:
 - a. A mechanical purge shall be available as an optional accessory to avoid excessive fan power.
 - b. When required the mechanical purge sector shall be factory installed and field adjustable.
 - c. Purge settings shall be calculated using AHRI certified data and adjusted per the wheel manufacturer's selection software.
 - d. Purge shall be capable of limiting Exhaust Air Transfer Ratio (EATR) values to 0.4% through proper fan and purge adjustment.

B. Sequence Of Operations

- 1. Building Automation System Interface: The Building Automation System (BAS) shall send the controller Occupied Bypass, Morning Warm-up/Pre-Cool, Occupied/Unoccupied and Heat/Cool modes. The BAS shall also send the discharge air temperature setpoint and the duct static pressure setpoint. If a BAS is not present, or communication is lost with the BAS the controller shall operate using default modes and setpoints.
- 2. Occupied: During occupied periods, the supply fan and relief fan shall run continuously, and the outside air and relief dampers shall open. The unit controller shall control the supply fan speed to maintain the current supply duct static pressure setpoint (adj.). The unit controller shall control the relief fan speed to maintain a constant volume (adj.).
- 3. Unoccupied: Space conditions shall be communicated via BAS or a hardwire space/temperature humidity sensor. Unoccupied starting sequence shall begin when the Unoccupied Heating, Cooling, or Dehumidification Mode is enabled. Otherwise, the unit shall remain dormant with the supply fan disabled. Supply Fan Startup sequence is identical to occupied operation. The OA damper shall be commanded to close, and the return air damper shall open. OAOA

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4. Cooling: Cooling Mode shall be enabled whenever the OAOA Temperature rises above the OAOA Cooling Enable Setpoint. The OAOA Temperature shall be above the OAOA Heating Enable Setpoint. During Cooling Mode, Cooling Capacity shall be adjusted to maintain Discharge Air Temperature Setpoint. Dehumidification Mode shall take priority over Cooling Mode. OACircuit 1 refrigeration pressure shall be monitored, and Cooling Capacity shall be limited to prevent the indoor coil from freezing. If the unit has digital scroll on the second circuit, then both circuits shall be monitored.
5. Primary Heating: Heating Mode shall be enabled whenever the OA Temperature is below the OA Heating Enable Setpoint. During Heating Mode, Heat Capacity shall be adjusted to maintain the Discharge Air Temperature to Discharge Air Temperature Setpoint.
6. Dehumidification: Dehumidification Mode shall be enabled whenever the OA Dewpoint rises above the OA Dewpoint Enable Setpoint. The OA Temperature Active must be above OA Heating Enable Setpoint. During Dehumidification Mode, Cooling Capacity shall be adjusted to maintain the Dehumidification Temperature Setpoint (adjustable). HGRH Valve Command shall be modulated to maintain Discharge Air Temperature Setpoint . If the HGRH Valve Command is at 100%, the hot water valve shall be energized with Heating Capacity at 0%. If Heat Capacity rises above 0%, the HGRH Valve Command shall be locked at 100% and the hot water shall modulate to maintain the Discharge Air Temperature Setpoint.
7. Energy Recovery Wheel Operation: The Energy Recovery Wheel (ERV) Start Stop Command shall be enabled whenever the unit is enabled. During Ventilation Mode or Economizer Mode the ERV shall be disabled, except during the cleaning cycle, which occurs for two minutes every thirty minutes. During Economizer Mode and Ventilation Mode the ERV bypass dampers shall be locked in the open position. The unit prevents frost accumulation on the ERV by measuring the differential pressure across the inlet and the outlet of the energy recovery wheel. If the OA temperature is below 5 deg. F (adj.) and the differential pressure across the energy recovery wheel is at 1.5 inches of water (adj.), the energy wheel variable speed drive shall slow down to defrost the wheel. The unit controller shall maintain the Relief Leaving Temperature by modulating the Energy Recovery OA Bypass Position Command open. During normal operation, the VSD is at 100% (full speed) and the bypass damper is at 0% (closed). The energy wheel shall resume normal operational speed when the pressure drop decreases to below the pressure switch setpoint (factory set) or the OA temperature has risen above the energy wheel outside air leaving temperature setpoint.
8. Ventilation: Ventilation Mode shall be enabled when the OA Temperature is between the OA Cooling Enable Setpoint and the OA Heating Enable Setpoint. During Ventilation Mode, heating and cooling shall be locked out and the unit shall supply un-conditioned air. Ventilation Mode shall be locked out whenever the unit is in Dehumidification Mode.
9. Supply Fan Operation: When the unit becomes occupied, the OA damper shall open. When the OA damper is completely open the damper end switch shall close indicating the damper is fully open and the supply fan sequence can begin. When the fan start sequence has begun, the unit controller shall command the variable speed drive for the supply fan to 50%. A supply fan status switch shall prove fan status. If after 2 minutes (adj.) the fan does not have a proven signal, the Supply Fan Failure alarm shall be

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displayed and the unit shall shutdown requiring a manual reset. After the startup sequence, the unit controller shall control the speed of the supply fan to maintain a Supply Duct Static Pressure Setpoint. If the supply duct static pressure reaches 3.00 inches of W.C. (adj.), the high limit pressure switch shall shut down the unit, requiring a manual reset to re-start the unit. Supply and relief fans are interlocked via software; a failure of either shall disable both.

10. Static Pressure High Limit: If for any reason the supply air pressure exceeds the supply air pressure high limit, the supply fan shall shut down. The unit shall be allowed to restart three times after a 15 minute off period. If the over-pressurization condition occurs on the fourth restart, the unit shall shut down and a manual reset diagnostic is displayed at the remote panel and/or the BAS system.
11. Filter Status: A differential pressure switch shall monitor the differential pressure across the filter(s) when the fan is running. If the switch closes during normal operation a dirty filter alarm shall annunciate at the BAS.
12. Smoke Detector Shutdown: The unit shall shut down in response to a signal from a smoke detector indicating the presence of smoke. The smoke detectors shall be interlocked to the unit through the dry contacts of the smoke detectors. A manual reset of the smoke detectors shall be required to restart the unit.
13. Condensate Overflow Shutdown: The unit shall shut down in response to a signal from the condensate overflow sensor. The sensor shall be interlocked to the unit cooling controller for immediate shutdown of cooling.

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 roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Protect unit interiors from moisture, construction debris and dust, and other foreign materials. Comply with Section 233113 "Ductwork" Paragraph: Field Quality Control.

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- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts.
- C. Unit Support: Provide unit level on structural steel supports. Coordinate roof penetrations and flashing with roof construction. Secure units to structural support with anchor bolts. Coordinate sizes and locations of steel supports with actual equipment provided.
- D. Provide filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.
- E. Provide separate devices furnished by manufacturer and not factory installed.
- F. Provide new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to units, allow space for service and maintenance.
- C. Connect piping to units mounted on vibration isolators with flexible connectors.
- D. Provide condensate drain piping and P-trap per manufacturer's instructions.
- E. Hydronic Piping Connections:
 - 1. Comply with requirements in Section 232113 "Hydronic HVAC Piping".
 - 2. Provide shutoff valve and union or flange on each supply connection and install balancing valve and union or flange on each return connection.
- F. Duct Connections:
 - 1. Comply with requirements in Section 233113 "Ductwork"
 - 2. Drawings indicate the general arrangement of ducts.
 - 3. Connect ducts to units with water-tight flexible duct connectors.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Division 26.
- B. Ground equipment in accordance with Division 26.
- C. Provide electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

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- D. Provide nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.
- E. Provide control and electrical power wiring to field-mounted control devices. Connect control wiring in accordance Division 26.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup-checks in accordance with manufacturer's written instructions.
 - 2. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
 - 3. Start refrigeration system when outdoor-air temperature is within normal operating limits. and measure and record the following:
 - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
 - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
 - c. Condenser coil entering-air dry-bulb temperature.
 - d. Condenser coil leaving-air dry-bulb temperature.
 - 4. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
 - 5. Inspect casing insulation for integrity, moisture content, and adhesion.
 - 6. Verify that clearances have been provided for servicing.
 - 7. Verify that controls are connected and operable.
 - 8. Verify that filters are installed.
 - 9. Clean coils and inspect for construction debris.
 - 10. Inspect and adjust vibration isolators.
 - 11. Verify bearing lubrication.
 - 12. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 13. Start unit.
 - 14. Inspect and record performance of interlocks and protective devices, including response to smoke detectors by fan controls and fire alarm.
 - 15. Operate unit for run-in period.
 - 16. Calibrate controls.
 - 17. Adjust and inspect high-temperature limits.
 - 18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 - 19. Verify operational sequence of controls.
 - 20. Measure and record the following airflows. Plot fan volumes on fan curve.

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- a. Supply-air volume.
 - b. Relief-air flow.
 - c. Outdoor-air flow.
- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

3.6 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 FIELD QUALITY CONTROL

- A. Cleaning:
 - 1. Comply with Section 233113 “Ductwork” Paragraph: Field Quality Control.
 - 2. After completing system installation; testing, adjusting, and balancing unit and air-distribution systems; and completing startup service, clean units internally to remove foreign material and construction dirt and dust. Clean fan wheels, casings, dampers, coils, and filter housings, and install new, clean filters.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Leak Test: After installation, fill coils with water, and test coils and connections for leaks.
 - 2. Charge refrigerant coils with refrigerant and test for leaks.
 - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Testing of Drain Pans. To minimize conditions of water stagnation that may result in microbial growth, inspect drain pans to verify proper drainage under operating conditions.

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3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237433

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SECTION 238130 – MULTIZONE, HEAT-PUMP HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 23 Section “Common Work Results”
- C. Division 23 Section “Refrigerant Piping”.

1.2 SUMMARY

- A. This Section ductless multi-zone heat pump systems.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- 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.
- C. A dry air holding charge shall be provided in the indoor section.
- D. The outdoor unit shall be pre-charged with refrigerant.

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1.6 WARRANTY

- A. The units shall have a manufacturer's parts and defects warranty for a period five (5) years from date of installation. The compressor shall have an extended warranty of seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty will not include labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Mitsubishi
 2. Daikin
 3. Fujitsu
 4. Trane
 5. Samsung

2.2 DUCTLESS MINI SPLIT SYSTEMS

- A. Outdoor Units: The outdoor units shall be specifically designed to work with the manufacturer's family of indoor units. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit shall be run tested at the factory prior to shipment.
1. Units need to provide year-round HVAC in a cold climate. Provide all available snow hoods (intakes and exhaust), wind baffles, base pan heaters, support stands, and other accessories. Cold climate low temperature heat pumps shall have 100% heating capacity at -5° and 70% to 81% heating capacity at -13° F.
 2. Provide hail guards.
 3. Unit Cabinet:
 - a. The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.
 - b. Cabinet color shall be Munsell 3Y 7.8/1.1.
 - c. Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes.

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4. Fan:
 - a. The unit shall be furnished with a direct drive, high performance propeller type fan.
 - b. The condenser fan motor shall be a variable speed, direct current (DC) motor and shall have permanently lubricated bearings.
 - c. Fan speed shall be switch automatically according to the number of operating indoor units and the compressor operating frequency.
 - d. The fan motor shall be mounted with vibration isolation for quiet operation.
 - e. The fan shall be provided with a raised guard to prevent contact with moving parts.
 - f. The outdoor unit shall have horizontal discharge airflow.
 - g. Outdoor unit sound level shall not exceed 55 dB (A).
5. Coil:
 - a. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
 - b. The coil shall be protected with an integral guard.
 - c. Refrigerant flow from the outdoor unit to the indoor units shall be independently controlled by means of individual electronic linear expansion valves for each indoor unit.
 - d. Outdoor unit shall be pre-charged with sufficient refrigerant for up to one hundred and thirty-one (131) feet of refrigerant piping.
 - e. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.
 - f. All refrigerant connections between outdoor and indoor units shall be flare type.
6. Compressor:
 - a. The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type.
 - b. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.
 - c. The outdoor unit shall be equipped with a suction side refrigerant accumulator.
 - d. The compressor will be equipped with an internal thermal overload.
 - e. The compressor shall be mounted to avoid the transmission of vibration.

B. Branch Boxes (as required):

1. The outdoor unit shall be connected to at least one branch box. The branch boxes shall be installed indoors in an area with a temperature between 67°F and 95°F and a relative humidity of 80% or lower.

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2. Piping Requirements: The outdoor unit must have the ability to operate without the need for line size changes, traps, or additional oil.
3. Electrical:
 - a. Enclosure: Metal, like enclosure, and suitable for unprotected outdoor locations.
 - b. Field Connection: Single point connection to power entire unit and integral controls.
 - c. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
 - d. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
 - e. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - f. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.

C. Unit Controls:

1. Factory-Installed Sensors:
 - a. Unit inlet air temperature.
 - b. Coil entering refrigerant temperature.
 - c. Coil leaving refrigerant temperature.
2. Interlock control sequence: Four digital inputs and three digital outputs for use in defined or customizable interlock sequences; relay adapter kits may be required. Required interlock sequences include:
 - a. Backup heat control relay (Mitsubishi CN24).
3. Features and Functions:
 - a. Self-diagnostics.
 - b. Time delay.
 - c. Auto-restart.
 - d. Auto operation mode.
 - e. Manual operation mode.
 - f. Filter service notification.
 - g. Run test switch.

D. Indoor Units: The indoor unit shall be fully factory assembled, wired, and run tested prior to shipment. Contained within the indoor unit shall be all factory wiring, piping, control circuit board, fan, and fan motor. The unit shall have a self-diagnostic function, 3-minute restart time delay mechanism, an auto restart function, an emergency / test operation. Indoor unit shall be charged with dry air before shipment from factory.

1. The indoor units shall be capable of working with single-zone or multi-zone outdoor units.
2. Provide a drain pan level switch, designed to connect to the control board.
3. Unit Cabinet:

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- a. The casing shall have a white finish– Munsell 1.0Y 9.2/0.2.
 - b. Multi directional drain and refrigerant piping, offering three (3) direction pipe alignment for all refrigerant piping and two (2) direction pipe alignment for condensate draining shall be standard.
 - c. There shall be a separate back plate that secures the indoor unit firmly to the wall. The installation-plate shall be securely attached to the wall using appropriate anchor method. Contractor shall determine the best method and be responsible for proper mounting of the installation plate to the wall.
4. Fan:
 - a. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.
 - b. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearing.
 - c. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
 - d. An integral, motorized, multi-position, horizontal air sweep flow louver shall provide for uniform air distribution, up and down. Five (5) positions plus Auto and Swing shall be provided, controlled from the remote controller.
 - e. The indoor fan shall operate at one of five (5) speeds: Super High, High, Medium, Low, and Quiet plus Auto Fan Mode for models up to 18,000 BTU/h, and four (4) speeds: Powerful, High, Medium and Low plus Auto Fan Mode for the 24,000 BTU/h model. All speeds shall be selected from the remote controller.
5. Filters, wall, and ceiling: Return air shall be filtered by means of an easily removed, washable, Catechin, Antioxidant Pre-filter and a separate Anti-allergy enzyme filter – blue, pleated type.
6. Coil:
 - a. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 - b. The refrigerant tubing shall have inner grooves for high efficiency heat exchange.
 - c. All tube joints shall be brazed with PhosCopper or silver alloy.
 - d. The coils shall be pressure tested at the factory.
 - e. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.
7. Electrical:
 - a. Enclosure: Metal, suitable for indoor locations.
 - b. Field Connection: Single point connection to power unit and integral controls.
 - c. Disconnecting Means: Factory-mounted circuit breaker or switch.
 - d. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
 - e. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - f. Raceways: Enclose line voltage wiring in raceways.

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E. Wired, Wall-Mounted Simple MA Remote Controller (PAC-YT53CRAU)

1. User defined functions:
 - a. ON/OFF
 - b. Operation mode: Auto, Cool, Heat, Fan, or Drying
 - c. Set temperature
 - d. Fan speed setting
 - e. Air flow direction
 - f. Set temperature range: 40°F - 95°F depending on operation mode and indoor unit connected.
2. Set temperature range limit: Simple MA allowable set temperature range can be reduced for cool and heat modes.
3. Room temperature can be sensed either at the indoor unit (default) or at the remote controller.
4. Wiring: Uses two-wire, stranded, non-polar control wire for connecting to the indoor unit or control adapter.
5. Requires crossover wiring for grouping across indoor units.
6. Dimensions: 2-3/4 x 9/16 x 4-3/4".
7. Provide external heat adapter.
8. Provide CN24 relay for controlling fin tube.

2.3 HVAC SYSTEM CONTROLS

A. General Requirements:

1. Mitsubishi Model AE-200A, or equal.
2. Network: Indoor units and outdoor units shall include integral controls and connect through a manufacturer-selected control network.
3. Network Communication Protocol: Manufacturer proprietary control communication between interconnected units.
4. Integration with BAS: Provide controller integration, must be compatible with existing Owner controls, coordinate with 230900. Provide either BACnet or Niagara, coordinate with Owner.
5. License for Integration with BAS: BACnet over IP communication of indoor unit monitor and control points. Niagara Driver for direct BAS connection to central controller for enhanced data set including indoor unit and control points plus outdoor unit monitor points in lieu of BACnet license.

- B. ASHRAE 135, BACnet IP and certified by BACnet Testing Lab (BTL), including Ethernet connection via RJ-45 connectors and port with transmission at 100 Mbps or higher. Integration shall include control, monitoring, scheduling, and change of value notifications.**

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1. Operator Interface:
 - a. Operators shall interface with system and unit controls through the following:
 - 1) Operator interfaces integral to controllers
 - 2) Manufacturer-provided central controller.
 - 3) Integration with Building Automation System.
 - 4) Secure-cloud access through web browser software with 1-year prepaid service subscription.
 - b. Users shall be capable of interface with controllers for indoor units' control to extent privileges are enabled. Control features available to users shall include the following:
 - 1) On/off control.
 - 2) Temperature set-point adjustment.
 - 3) Fan speed control.
 - c. Interface via secure-cloud access shall allow downloading of system diagnostic information, viewable system diagnostic charts, refrigerant volume check, branch port check, test run initiation, and email notification of error codes.

C. Central Controllers:

1. Centralized control for all indoor and outdoor units from a single central controller location.
 - a. Include multiple interconnected controllers as required.
 - b. Include backlit, high-resolution color display touch panel.
2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
 - a. Sets schedule for daily, weekly, and annual events.
 - b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.
4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
6. Night-setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.

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7. Able to disable and enable operation of individual controllers for indoor units.
8. Information displayed on individual controllers shall also be available for display through central controller.
9. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
10. Start/stop control capability for third-party equipment as required.
11. DIN rail mounting kit for installation of central controller in an enclosure.

2.4 OUTDOOR EQUIPMENT STANDS

A. Outdoor Unit Stands

1. Mitsubishi, Samsung, Daikin, Quick-Sling, or approved equal.
2. Steel tubing powder coated for outdoor use, sized to match the equipment dimensions and weight. Provide adjustable channel cross bars and clamps/fasteners/bolts in a prefabricated system that can be modularly assembled on-site. Height shall be adjustable.
3. Base Mounted Foot Material: Steel, shall be bolted to support. Stand height: 18”.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION, GENERAL

A. Examination

1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
2. Examine products before installation. Reject products that are wet, moisture damaged, or mold damaged.
3. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.
4. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.
5. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.
6. Examine for suitable conditions where equipment will be installed. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Service Access:

1. Provide and document service access requirements.
2. Maintain manufacturer's recommended clearances for service and maintenance.
3. Maintain clearances required by governing code.
4. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.

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5. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
6. If less than full and unrestricted access is provided, locate components within an 18-inch reach of the finished assembly.
7. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
8. Comply with OSHA regulations.

3.2 INSTALLATION OF INDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Unless otherwise required by HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; rod size per manufacturer instructions.
- C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
- D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
- E. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch.
- F. For wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.
- G. Attachment: Install hardware for proper attachment to supported equipment.
- H. Grouting: Place grout under equipment supports and make bearing surface smooth.

3.3 INSTALLATION OF OUTDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Anchor units to supports with removable, cadmium-plated fasteners.
- C. Provide roof-mounting condensing unit support components bolted to roof sleepers that are securely fastened to the roof structure. Provide flashing in accordance with Division 7.
- D. Provide roof piping penetrations as per Section 230500

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3.4 REFRIGERANT PIPING

- A. Provide per Section 232300.
- B. Refrigerant: Provide as required by HVAC system manufacturer for system to comply with performance requirements indicated.
- C. Oil: Provide as required by HVAC system manufacturer and to comply with performance requirements indicated.
- D. Pre-insulated line sets may be used if approved by the heat pump manufacturer, provided the line sets meet all requirements set forth by the manufacturer and all joints are brazed.
- E. Provide piping adjacent to unit to allow service and maintenance.
- F. Coordinate locations of indoor units with structure, ceiling grid, and other trades – must maintain heat pump manufacturer's recommended service clearances.
- G. Provide roof piping penetrations as per Section 230500.

3.5 CONDENSATE DRAINS

- A. Provide condensate pump. See specification section 221316 "Plumbing Sanitary & Storm Piping".
- B. Provide a drain pan level switch, installed on the condensate pan to prevent condensate from overflowing. Provide integration with the BAS as specified in Section 230900 "Instrumentation & Control".

3.6 ELECTRICAL

- A. Electrical: Comply with requirements indicated on Drawings and in applicable Division 26 Sections.
- B. Provide a programmable 3-phase line voltage monitor for each outdoor unit, see 230500.
- C. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- D. Electrical Connections: Comply with requirements in Electrical Specification Sections for power wiring, switches, and motor controls.

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3.7 INSTALLATION OF SYSTEM CONTROL CABLE

- A. Comply with NECA 1.
- B. Low-Voltage Control Cabling: Provide per Division 26, NFPA 70, and equipment manufacturer's instructions.
- C. General Requirements for Cabling:
 - 1. Comply with TIA-568-C Series of standards.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
 - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable.
 - 5. Cables serving a common system may be grouped in a common raceway. Install control cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
 - 6. 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.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Do not use heat lamps for heating.
 - 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
 - 11. Support: Do not allow cables to lie on removable ceiling tiles or access panels.
 - 12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
 - 13. Provide strain relief.
 - 14. Keep runs short. Allow extra length for connecting to terminals.
 - 15. Do not bend cables in a radius less than 10 times the cable OD.
 - 16. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
 - 17. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
- D. Balanced Twisted-Pair Cable Installation: Comply with TIA-568-C.2. Do not untwist balanced twisted-pair cables more than 1/2 inch at the point of termination to maintain cable geometry.
- E. Open-Cable Installation: Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

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- F. Separation from EMI Sources: Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded cable from potential EMI sources including electrical power wiring and equipment.

3.8 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- B. Engage a factory-authorized service representative to perform startup service. Complete installation and startup checks according to manufacturer's written instructions.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Check control communications of equipment and each operating component in system(s).
 - 3. Check each indoor unit's response to demand for cooling and heating.
 - 4. Check each indoor unit's response to changes in airflow settings.
 - 5. Check each indoor unit, HRCU, and outdoor unit for proper condensate removal.
 - 6. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 7. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
- B. Refer to Division 1 for further requirements.

END OF SECTION 238130

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SECTION 238233 - CONVECTION HEATING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following: Division 23 Section "Common Work Results"

1.2 SUMMARY

- A. This Section includes hydronic convection heating units.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated. Enclosure joints, corner pieces, access doors, and other accessories.
- B. Color Samples for Initial Selection: For units with factory-applied color finishes.
- C. Operation and Maintenance Data: For convection heating units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. 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.
- B. Factory test and rate finned-tube radiators according to Hydronic Institute's "Testing and Rating Standard for Finned-Tube (Commercial) Radiation."
- C. Performance Ratings: Rate according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

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PART 2 - PRODUCTS

2.1 COMMERCIAL HOT-WATER FINNED-TUBE RADIATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Sterling
 - 2. Trane
 - 3. Rittling
 - 4. Slant/Fin.
 - 5. Trane.
 - 6. Vulcan
- B. Furnish and install where shown on all plans, Sterling Versa-Line Finned-Tube or approved equal quality and capacity.
- C. Heating Elements as scheduled:
 - 1. Seamless copper tubing suitable for soldered fittings, mechanically expanded into evenly spaced aluminum fins.
 - 2. Tube Diameter: as scheduled.
 - 3. Fin Size: as scheduled.
- D. Partial back plates shall be machine roll formed, pre-painted, 20-gauge steel with formed mounting channel into which the enclosure shall self-locate and secure.
- E. All brackets and hangers shall be die-formed 14-gauge galvanized steel with channel type wiped edge construction for rigidity. Nickel-chromium plated ball bearings inserted into a nylon isolator insert shall be used in conjunction with an 18 gauge galvanized die-formed element support cradle to provide friction free lateral movement during expansion and contraction. Brackets shall have preformed contour at the top allowing the bracket to interlock with the back-plate channel. Brackets shall be self-locating in the vertical (height) position. Full engagement enclosure locks are to be supplied with each bracket.
- F. Hangers shall provide for vertical element adjustment when pitch is required. Water applications do not require adjustable hangers.
- G. Finned-tube enclosures
 - 1. Style and size as scheduled.
 - 2. Enclosure Style: Sloped top.
 - 3. Material shall be 16-gauge cold rolled steel with baked primer suitable for field painting.
 - 4. Air discharge and/or inlet louvers shall be "pencil proof."
 - 5. Welded male and female slip joints shall be provided at each end to allow for positive engagement and alignment of adjoining enclosures.
 - 6. Internal 14-gauge gussets (minimum of two) shall be welded into place at ends of each enclosure style and design configuration.

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7. All bends (lateral) on enclosure are to be formed on bottoming dies to ensure continuity of all adjoining enclosures and accessories.
8. Finish: Factory-applied baked enamel in manufacturer's standard color.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive convection heating units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for hydronic-piping connections to verify actual locations before convection heating unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL

- A. Provide units level and plumb.
- B. Provide valves within reach of access door provided in enclosure.
- C. Provide piping adjacent to units to allow service and maintenance.

3.3 INSTALLATION

- A. Provide enclosure continuously around corners, using outside and inside corner fittings.
- B. Join sections with splice plates and filler pieces to provide continuous enclosure.
- C. Provide enclosure continuously from wall to wall.
- D. At end of each run, provide a 3-foot section to allow for removal and access to valves.
- E. Terminate enclosures with manufacturer's end caps, except where enclosures are indicated to extend to adjoining walls.
- F. Expansion joints shall be provided in accordance with Section 230516 "Expansion Fittings And Loops For HVAC Piping". Fintube backplate shall be compatible with the specified guides and anchors.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

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- B. Connect hot-water units and components to piping according to Division 23 Section "Hydronic Piping."
- C. Provide control valves as specified.
- D. Provide piping adjacent to convection heating units to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

- A. Perform a leak test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- B. Remove and replace convection heating units that do not pass tests and inspections and retest as specified above.

END OF SECTION 238233

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SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 REFERENCES

- A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive; also called "variable-frequency drive" (VFD).
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. cd: Candela, the SI fundamental unit of luminous intensity.
17. CO/ALR: Copper-aluminum, revised.
18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).
28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.

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- 30. EMF: Electromotive force.
- 31. EMI: Electromagnetic interference.
- 32. EPM: Electrical preventive maintenance.
- 33. EPS: Emergency power supply.
- 34. EPSS: Emergency power supply system.
- 35. ESS: Energy storage system.
- 36. EV: Electric vehicle.
- 37. EVPE: Electric vehicle power export equipment.
- 38. EVSE: Electric vehicle supply equipment.
- 39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
- 40. FLC: Full-load current.
- 41. ft: Foot.
- 42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
- 43. GEC: Grounding electrode conductor.
- 44. GFCI: Ground-fault circuit interrupter.
- 45. GFPE: Ground-fault protection of equipment.
- 46. GND: Ground.
- 47. HACR: Heating, air conditioning, and refrigeration.
- 48. HDPE: High-density polyethylene.
- 49. HID: High-intensity discharge.
- 50. HP or hp: Horsepower.
- 51. HVAC: Heating, ventilating, and air conditioning.
- 52. Hz: Hertz.
- 53. IBT: Intersystem bonding termination.
- 54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
- 55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
- 56. IR: Infrared.
- 57. IS: Intrinsically safe.
- 58. IT&R: Inspecting, testing, and repair.
- 59. ITE: Information technology equipment.
- 60. kAIC: Kiloampere interrupting capacity.
- 61. kcmil or MCM: One thousand circular mils.
- 62. kV: Kilovolt.
- 63. kVA: Kilovolt-ampere.
- 64. kVAr or kVAR: Kilovolt-ampere reactive.
- 65. kW: Kilowatt.
- 66. kWh: Kilowatt-hour.
- 67. LAN: Local area network.
- 68. lb: Pound (weight).
- 69. lbf: Pound (force).
- 70. LCD: Liquid-crystal display.
- 71. LCDI: Leakage-current detector-interrupter.
- 72. LED: Light-emitting diode.

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- 73. Li-ion: Lithium-ion.
- 74. lm: Lumen, the SI derived unit of luminous flux.
- 75. LNG: Liquefied natural gas.
- 76. LP-Gas: Liquefied petroleum gas.
- 77. LRC: Locked-rotor current.
- 78. LV: Low voltage.
- 79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
- 80. m: Meter.
- 81. MCC: Motor-control center.
- 82. MDC: Modular data center.
- 83. MG set: Motor-generator set.
- 84. MIDI: Musical instrument digital interface.
- 85. MLO: Main lugs only.
- 86. MV: Medium voltage.
- 87. MVA: Megavolt-ampere.
- 88. mW: Milliwatt.
- 89. MW: Megawatt.
- 90. MWh: Megawatt-hour.
- 91. NC: Normally closed.
- 92. Ni-Cd: Nickel-cadmium.
- 93. Ni-MH: Nickel-metal hydride.
- 94. NIU: Network interface unit.
- 95. NO: Normally open.
- 96. NPT: National (American) standard pipe taper.
- 97. OCPD: Overcurrent protective device.
- 98. ONT: Optical network terminal.
- 99. PC: Personal computer.
- 100. PCS: Power conversion system.
- 101. PCU: Power-conditioning unit.
- 102. PF or pf: Power factor.
- 103. PHEV: Plug-in hybrid electric vehicle.
- 104. PLC: Programmable logic controller.
- 105. PLFA: Power-limited fire alarm.
- 106. PoE: Power over Ethernet.
- 107. PV: Photovoltaic.
- 108. PVC: Polyvinyl chloride.
- 109. pW: Picowatt.
- 110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
- 111. RMS or rms: Root-mean-square.
- 112. RPM or rpm: Revolutions per minute.
- 113. SCADA: Supervisory control and data acquisition.
- 114. SCR: Silicon-controlled rectifier.
- 115. SPD: Surge protective device.
- 116. sq.: Square.
- 117. SWD: Switching duty.
- 118. TCP/IP: Transmission control protocol/Internet protocol.
- 119. TEFC: Totally enclosed fan-cooled.
- 120. TR: Tamper resistant.
- 121. TVSS: Transient voltage surge suppressor.

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- 122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
- 123. UL CCN: UL Category Control Number.
- 124. UPS: Uninterruptible power supply.
- 125. USB: Universal serial bus.
- 126. UV: Ultraviolet.
- 127. V: Volt, unit of electromotive force.
- 128. V(ac): Volt, alternating current.
- 129. V(dc): Volt, direct current.
- 130. VA: Volt-ampere, unit of complex electrical power.
- 131. VAR: Volt-ampere reactive, unit of reactive electrical power.
- 132. VFC: Variable-frequency controller.
- 133. VOM: Volt-ohm-multimeter.
- 134. VPN: Virtual private network.
- 135. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
- 136. W: Watt, unit of real electrical power.
- 137. Wh: Watt-hour, unit of electrical energy usage.
- 138. WPT: Wireless power transfer.
- 139. WPTE: Wireless power transfer equipment.
- 140. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

- 1. CR: Communications raceway.
- 2. CR-GP: General-purpose communications raceway.
- 3. CR-P: Plenum communications raceway.
- 4. CR-R: Riser communications raceway.
- 5. EMT: Electrical metallic tubing.
- 6. EMT-A: Aluminum electrical metallic tubing.
- 7. EMT-S: Steel electrical metallic tubing.
- 8. EMT-SS: Stainless steel electrical metallic tubing.
- 9. ENT: Electrical nonmetallic tubing.
- 10. EPEC: Electrical HDPE underground conduit (thin wall).
- 11. EPEC-A: Type A electrical HDPE underground conduit.
- 12. EPEC-B: Type B electrical HDPE underground conduit.
- 13. ERMC: Electrical rigid metal conduit.
- 14. ERMC-A: Aluminum electrical rigid metal conduit.
- 15. ERMC-S: Steel electrical rigid metal conduit.
- 16. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
- 17. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
- 18. ERMC-SS: Stainless steel electrical rigid metal conduit.
- 19. FMC: Flexible metal conduit.
- 20. FMC-A: Aluminum flexible metal conduit.
- 21. FMC-S: Steel flexible metal conduit.
- 22. FMT: Steel flexible metallic tubing.
- 23. FNMC: Flexible nonmetallic conduit. See "LFNC."
- 24. HDPE: HDPE underground conduit (thick wall).
- 25. HDPE-40: Schedule 40 HDPE underground conduit.
- 26. HDPE-80: Schedule 80 HDPE underground conduit.

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27. IMC: Steel electrical intermediate metal conduit.
28. LFMC: Liquidtight flexible metal conduit.
29. LFMC-A: Aluminum liquidtight flexible metal conduit.
30. LFMC-S: Steel liquidtight flexible metal conduit.
31. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
32. LFNC: Liquidtight flexible nonmetallic conduit.
33. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
34. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
35. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
36. OFR: Optical fiber raceway.
37. OFR-GP: General-purpose optical fiber raceway.
38. OFR-P: Plenum optical fiber raceway.
39. OFR-R: Riser optical fiber raceway.
40. PVC: Rigid PVC conduit.
41. PVC-40: Schedule 40 rigid PVC conduit.
42. PVC-80: Schedule 80 rigid PVC Conduit.
43. PVC-A: Type A rigid PVC concrete-encased conduit.
44. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
45. RGS: See ERM-C-S-G.
46. RMC: See ERM-C.
47. RTRC: Reinforced thermosetting resin conduit.
48. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
49. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
50. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
51. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
52. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.

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- 17. CMR: Communications riser cable.
- 18. CMUC: Under-carpet communications wire and cable.
- 19. CMX: Communications cable, limited use.
- 20. DG: Distributed generation cable.
- 21. FC: Flat cable.
- 22. FCC: Flat conductor cable.
- 23. FPL: Power-limited fire-alarm cable.
- 24. FPLP: Power-limited fire-alarm plenum cable.
- 25. FPLR: Power-limited fire-alarm riser cable.
- 26. IGS: Integrated gas spacer cable.
- 27. ITC: Instrumentation tray cable.
- 28. ITC-ER: Instrumentation tray cable, exposed run.
- 29. MC: Metal-clad cable.
- 30. MC-HL: Metal-clad cable, hazardous location.
- 31. MI: Mineral-insulated, metal-sheathed cable.
- 32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
- 33. MV: Medium-voltage cable.
- 34. NM: Nonmetallic sheathed cable.
- 35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
- 36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
- 37. NPLF: Non-power-limited fire-alarm circuit cable.
- 38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
- 39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
- 40. NUCC: Nonmetallic underground conduit with conductors.
- 41. OFC: Conductive optical fiber general-purpose cable.
- 42. OFCG: Conductive optical fiber general-purpose cable.
- 43. OFCP: Conductive optical fiber plenum cable.
- 44. OFCR: Conductive optical fiber riser cable.
- 45. OFN: Nonconductive optical fiber general-purpose cable.
- 46. OFNG: Nonconductive optical fiber general-purpose cable.
- 47. OFNP: Nonconductive optical fiber plenum cable.
- 48. OFNR: Nonconductive optical fiber riser cable.
- 49. P: Marine shipboard cable.
- 50. PLTC: Power-limited tray cable.
- 51. PLTC-ER: Power-limited tray cable, exposed run.
- 52. PV: Photovoltaic cable.
- 53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
- 54. RHW: Thermoset rubber, moisture-resistant cable.
- 55. SA: Silicone rubber cable.
- 56. SE: Service-entrance cable.
- 57. SER: Service-entrance cable, round.
- 58. SEU: Service-entrance cable, flat.
- 59. SIS: Thermoset cable for switchboard and switchgear wiring.
- 60. TBS: Thermoplastic cable with outer braid.
- 61. TC: Tray cable.
- 62. TC-ER: Tray cable, exposed run.
- 63. TC-ER-HL: Tray cable, exposed run, hazardous location.
- 64. THW: Thermoplastic, heat- and moisture-resistant cable.

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- 65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
- 66. THHW: Thermoplastic, heat- and moisture-resistant cable.
- 67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
- 68. TW: Thermoplastic, moisture-resistant cable.
- 69. UF: Underground feeder and branch-circuit cable.
- 70. USE: Underground service-entrance cable.
- 71. XHH: Cross-linked polyethylene, heat-resistant cable.
- 72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:

- 1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
- 2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
- 3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
- 4. SEOOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
- 5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
- 6. SJEOO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
- 7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
- 8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
- 9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
- 10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
- 11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
- 12. SJOOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
- 13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
- 14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
- 15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
- 16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.

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17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
24. STOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
 - a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.
2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.

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8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
 - f. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
 - j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
 - k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 - m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
 - n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - o. Raised-Floor Box: A floor box intended for use in raised floors.
 - p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
 - q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.

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- r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 - s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 - t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.
12. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.
- a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
13. 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.
14. Jacket: A continuous nonmetallic outer covering for conductors or cables.
15. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
16. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
17. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
18. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
19. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
20. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
21. Sheath: A continuous metallic covering for conductors or cables.

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- 22. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
- 23. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
 - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
 - c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
 - d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
 - e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
 - f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.
- 24. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify Owner and engineer of record no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
 - 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Exercising generators.
 - b. Emergency lighting.

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- c. Elevators.
- d. Fire-alarm systems.

- B. Arrange to provide temporary electrical power to support construction effort in accordance with requirements specified in Division 01.

1.4 PREINSTALLATION MEETINGS

- A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than 10 days after notice to proceed. Agenda topics include, but are not limited to, the following:
 - 1. Electrical installation schedule.
 - 2. Status of power system studies.
 - 3. Value analysis proposals and requests for substitution of electrical equipment.
 - 4. Utility work coordination and class of service requests.
 - 5. Commissioning activities.

1.5 SEQUENCING

- A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.6 SCHEDULING

- A. Generated by contractor for review by owner and engineer of record.

1.7 ACTION SUBMITTALS

- A. Coordination drawings.

1.8 INFORMATIONAL SUBMITTALS

- A. Electrical installation schedule.
- B. Qualification statements.

1.9 CLOSEOUT SUBMITTALS

- A. Facility EPM program binders.
- B. Operation and maintenance data.

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1.10 QUALITY ASSURANCE

A. Qualifications: Prepare and submit qualification statements for the following entities performing Work on Project:

1. Qualified Regional Manufacturer: Manufacturer, possessing qualifications that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.
2. Structural Professional Engineer: Professional engineer possessing active qualifications with expertise in structural engineering.
3. Electrical Professional Engineer: Professional engineer possessing active qualifications with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.
4. ERM-C-S-PVC Installers: Installer possessing active qualifications and able to present unexpired certified Installer credentials issued by ERM-C-S-PVC manufacturer prior to starting installation.
5. Medium-Voltage Cable Installer: Entity possessing active qualifications with training and manufacturer certification to install, splice, and terminate medium-voltage cable in accordance with electrical utility service provider's requirements.
 - a. Medium-voltage cable Installer must be approved by owner.
6. Medium-Voltage Duct Installer: Entity possessing active qualifications with documented training and experience with installation of medium-voltage duct banks in accordance with electrical utility service provider's requirements.
 - a. Medium-voltage duct Installer must be approved by owner.
7. Medium-Voltage Equipment Installer: Entity possessing active qualifications with documented training and experience with hazards and safety requirements associated with installation and operation of medium-voltage equipment in accordance with electrical utility service provider requirements.
 - a. Medium-voltage equipment Installer must be approved by owner.
8. Medium-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - a. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.
9. Power-Limited Electrical Testing Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - a. On-site power-limited testing supervisor must have BICSI Registered Communications Distribution Designer certification and documented training and

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experience with testing power-limited equipment in accordance with NETA testing standards.

B. Certifications:

1. Seismic-Load Performance Certificates: Provide special certification for designated seismic systems as indicated in Paragraph 13.2.2 "Special Certification Requirements for Designated Seismic Systems" of ASCE/SEI 7-05 for all designated seismic-load systems identified on Drawings or in the Specifications.
 - a. Include the following information:
 - 1) Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2) Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4) Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
 - 5) Provide equipment manufacturer's written certification for each designated active electrical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction, or experience data as permitted by ASCE/SEI 7-05.
 - 6) Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7-05.
 - 7) Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by qualified structural professional engineer.
 - b. The following systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:
 - 1) Hangers and supports specified in Section 260529 "Hangers and Supports for Electrical Systems."
 - 2) Equipment, accessories, and components specified in Section 261219 "Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers."

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

- A. Substitution requests for electrical equipment will be entertained under the following conditions:**

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1. Notification of Contractor's intent to request substitutions for convenience must be declared during the Electrical Preconstruction Conference so potential risks to system performance and construction schedule may be identified for Contractor's response in submission of the substitution request. Submission of requests for substitutions for convenience must meet the conditions and deadline specified in Section 012500 "Substitution Procedures" to receive approval.
2. For electrical equipment and systems, substitutions for cause are considered major construction risks. If it is possible that Contractor may need to request substitutions for cause because of equipment unavailability, or inability to meet construction schedule because of lead time, Contractor must declare the possibility during the Electrical Preconstruction Conference to permit establishing a mitigation plan for minimizing risks to system performance and construction schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions
- B. Preinstallation Testing
- C. Evaluation and Assessment

3.2 PREPARATION

- A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
 1. Submission of power system studies.
 2. Submission of specified coordination drawings.
 3. Submission of action submittals specified in Division 26.
 4. Orders placed for major electrical equipment.
 5. Arrival of major electrical equipment on-site.
 6. Preinstallation meetings specified in Division 26.
 7. Utility service outages.
 8. Utility service inspection and activation.
 9. Requests for inspections by authorities having jurisdiction.
- B. Coordination Drawings for Large Equipment Outdoor Installations:
 1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:

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- a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
- b. Indicate clear dimensions for fence gates and wall openings.
- c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
- d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
- e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
- f. Dimensioned working clearances and dedicated areas around electrical equipment.

C. Coordination Drawings for Duct Banks:

1. Show duct profiles and coordination with other utilities and underground structures.
2. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

D. Protection of In-Place Conditions

3.3 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 Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.4 SYSTEM STARTUP

A. Commissioning Activities:

1. Medium voltage cable, medium voltage transformer, low voltage cable and all related termination devices.

3.5 FIELD QUALITY CONTROL

A. Adminstrant for Medium-Voltage Electrical Tests and Inspections:

1. Engage qualified medium-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

B. Adminstrant for Low-Voltage Electrical Tests and Inspections:

1. Administer and perform tests and inspections with assistance of factory-authorized service representative.

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C. Administrant for Power-Limited Electrical Tests and Inspections:

1. Engage qualified power-limited electrical testing and inspecting agency to administer and perform tests and inspections.

3.6 CLEANING

A. Waste Management:

1. Coordinate with owner for location to turn over removed transformer for on site storage

3.7 CLOSEOUT ACTIVITIES

A. Operation and Maintenance Data: Prepare and submit the following:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:
 - a. New medium voltage transformer
 - b. New medium voltage cable.
2. Include the following information:
 - a. Manufacturer's operating specifications.
 - b. User's guides for software and hardware.
 - c. Schedule of maintenance material items recommended to be stored at 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 Project, with ANSI and manufacturers' codes.
 - h. Manufacturer's instructions for setting field-adjustable components.
 - i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
 - j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.
 - k. Exterior pole inspection and repair procedures.
 - l. Include copies of demonstration and training videos.

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- B. Training: With assistance from factory-authorized service representatives, train Owner's maintenance personnel on the following topics:
 - 1. How to adjust, operate, and maintain equipment specified in Section 261219 "Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers."

END OF SECTION

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SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. General requirements applicable to all Division 26 sections.
 - 2. Temporary power and lighting.

1.3 TEMPORARY POWER AND LIGHTING

- A. The existing electrical service shall be the source for temporary power.
- B. Power Distribution: Provide weatherproof, grounded circuits with ground-fault interruption features, with proper power characteristics and either permanently wired or plug-in connections as appropriate for intended use. Provide overload-protected disconnect switch for each circuit at distribution panel. Space 4-gang convenience outlets (20 amp circuit) so that every portion of work can be reached with 100' extension cord.
- C. Temporary Lighting: Provide lighting of intensity and quality sufficient for proper and safe performance of the work and for access thereto and security thereof, minimum average illumination level in every room shall be 20 footcandles.

1.4 GENERAL REQUIREMENTS APPLICABLE TO ALL DIVISION 26 SECTIONS

- A. Regulatory Requirements:
 - 1. Conform to the requirements of all laws and regulations applicable to the work.
 - 2. Conform to the requirements of Federal State and Municipal Building Codes.
 - 3. Cooperate with all authorities having jurisdiction.
 - 4. Compliance with laws and regulations governing the work on this project does not relieve the Contractor from compliance with more restrictive requirements contained in these specifications.
 - 5. If the Contract Documents are found to be at variance with any law or regulation, the Contractor shall notify the Architect/Engineer promptly in writing. The Contractor shall assume full responsibility for any work contrary to law or regulation, and shall bear all costs for the corrections thereof.

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6. Minimum Requirements: The National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), the National Fire Codes, and National Fire Protection Association (NFPA) are a minimum requirement for work under this section. Design drawings and other specification sections shall govern in those instances where requirements are greater than those required by code.

B. REFERENCES

1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
 - a. National Fire Protection Association (NFPA).
 - b. National Electrical Code (NEC)
 - c. National Electrical Safety Code (NESC)
 - d. Underwriters Laboratories, Inc. (UL)
 - e. American National Standards Institute (ANSI)
 - f. Certified Ballast Manufacturers Association (CBM)
 - g. National Electrical Manufacturers Association (NEMA)
 - h. International Municipal Signal Association (IMSA)
 - i. Institute of Electrical and Electronic Engineers (IEEE)
 - j. American Society for Testing Materials Specifications (ASTM)
 - k. National Bureau of Standards Handbook (NBS)
 - l. Occupational Safety and Health Administration (OSHA)
 - m. Americans with Disabilities Act (ADA)
 - n. Insulated Power Cable Engineers Association Specifications (IPCEA)

C. Permits, Fees, and Inspections:

1. Secure and pay for all permits, fees, licenses, inspections, etc., required for the work under Division 26.
2. Schedule and pay for all legally required inspections and cooperate with inspecting officers.
3. Provide Certificates of Inspection and Approval from all regulatory authorities having jurisdiction over the work in Division 26.

- D. The Contractor shall study all drawings and specifications, visit the site, and acquaint itself with the existing conditions and the requirements of the plans and specifications. No claim will be recognized for extra compensation due to the failure of the Contractor to familiarize itself with the conditions and extent of the proposed work.

1.5 EFFICIENCY MAINE

- A. This project intends to pursue Efficient Maine prescriptive and/or custom incentives. The contractor shall be an Efficiency Maine Qualified Partner and shall participate in the activities associated with Efficiency Maine incentive pre-approval and approval process including but not limited to; preparation and submission of required incentive application(s) and the tracking and submission of measure specific invoices to Efficiency Maine within 60 days of the completion of the work.

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- B. The contractor shall also:
 - 1. Become familiar with the Efficiency Maine Business Program including available incentives and the application and review process.
 - 2. Review plans and specifications for any and all lighting and lighting control incentive opportunities, prescriptive and custom.
 - 3. Participate and support the effort for advancing and completing the application process for lighting, lighting control and HVAC rebates.
- C. The project schedule shall reflect and accommodate the time required to achieve application preapproval from Efficiency Maine. No equipment shall be purchased until preapproval is received from Efficiency Maine.
- D. All invoices shall be forwarded to Efficiency Maine in accordance with Efficiency Maine requirements. This deliverable shall be shown on the project schedule as a milestone date and coordinated with all contractors to assure compliance with this requirement.

1.6 COORDINATION

- A. Coordinate the work of Division 26 with other Divisions, the Owner, and utility companies.
- B. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- D. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION – Not Used

END OF SECTION 260100

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Metal-clad cable, Type MC, rated 600 V or less.
4. Armored cable, Type AC, rated 600 V or less.
5. Fire-alarm wire and cable.
6. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 271313 "Communications Copper Backbone Cabling" for twisted pair cabling used for data circuits.
2. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.

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- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire Company.
 - 2. American Bare Conductor.
 - 3. Belden Inc.
 - 4. General Cable Technologies Corporation.
 - 5. Okonite Company (The).
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. 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 B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type NM: Comply with UL 83 and UL 719.
 - 2. Type RHW-2: Comply with UL 44.
 - 3. Type SE: Comply with UL 854.
 - 4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 - 5. Type THHN: Comply with UL 83.
 - 6. Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 - 7. Type UF: Comply with UL 83 and UL 493.
 - 8. Type XHHW-2: Comply with UL 44.

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F. Shield:

1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; a part of Atkore International.
2. Belden Inc.
3. General Cable Technologies Corporation.

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. RoHS compliant.
4. 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 and multicircuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 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: Aluminum, interlocked.

- I. Jacket: PVC applied over armor.

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2.3 FIRE-ALARM WIRE AND CABLE

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [Allied Wire & Cable Inc.](#)
 2. [Comtran Corporation.](#)
 3. [Genesis Cable Products; Honeywell International, Inc.](#)
 4. [Radix Wire.](#)
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NRTL listed for fire-alarm and cable tray installation, plenum rated.

2.4 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [3M Electrical Products.](#)
 2. [Hubbell Power Systems, Inc.](#)
 3. [Ideal Industries, Inc.](#)
 4. [O-Z/Gedney; a brand of Emerson Industrial Automation.](#)
- 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.

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1. Material: Copper.
2. Type: Two hole with standard barrels.
3. Termination: Crimp.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

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 THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. VFC Output Circuits: Type TC-ER cable with braided shield.

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3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. 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."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 INSTALLATION OF FIRE-ALARM WIRING

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method:
 - 1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 - 2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted.
 - 3. Signaling Line Circuits: Power-limited fire-alarm cables shall not be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.

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- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: **1-inch** conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least **12 inches** of slack.
- D. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

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3.8 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."

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors feeding the following critical equipment and services for compliance with requirements:
 - 3. 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.
 - 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

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- a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. 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 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 a Summary of Project information, access, restrictions, and miscellaneous provisions.

1.3 PROJECT INFORMATION

- A. Project Identification: ***Masonry Renovation and Flashing at Lewiston District Court*** located at 71 Lisbon St, Lewiston, ME 04240.
- B. BGS Project Number: PT_3794

- 1. Allied Engineering # 2461-66956-00

- C. Owner:

- 1. Owner's Representative:
Kevin Fogg Facilities Engineer
Judicial Branch
71 Lisbon Street
Lewiston, Me 04243-1345

- D. Engineer: Allied Engineering, Inc., 160 Veranda Street, Portland, ME 04103

- 1. William P. Faucher, PE, SECB, LEED, RRC
Allied Engineering, Inc.
160 Veranda St
Portland, ME 04103

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following infrastructure improvements:
- B. Brief Description of Scope: Includes but is not limited to the following summary. Refer to project manual for complete presentation of project scope.

- C. Includes but is not limited to the following summary. Refer to project manual for complete presentation of project scope.
 - 1. Rake/repoint mortar joints for full façade as noted on drawings.
 - 2. Install counter reglet flashing and integral termination j-bar for fulllength wall above EPDM termination at sidewall..
 - 3. Existing window head flashing shall be replaced and will require removal/replacement of soldier coursing to facilitate the flashing installation..
- D. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.5 ACCESS TO SITE

- A. General: This project site is part of a secured, operating District Court facility. Much of the construction on the surface of an active court facility. The Owner's use of the facility will continue without interruption during all phases of the project. The contractor shall have limited access to this facility for construction operations during the construction period. Access shall be limited to the extent necessary for the Owner's continued operation of the existing facility.
- B. Site and building security will be maintained before, during and after construction, at all times of the day or night. To accommodate the work, the Contractor shall establish operating temporary control and workstations for facility operations. There may be periods of shutdown required by Court Judges that shall be anticipated and planned for accommodating in session court time.
- C. The contractor shall plan and coordinate a security plan and schedule with the owner prior to start of construction, and once approved not deviate from the approved plan and schedule without written approval of any change not less than 72 hours prior to any change. The owner has the right to modify or reject the plan at the owner's discretion.
- D. All emergencies shall be reported to the facility construction entrance officer who will, depending upon the location of the emergency event, initiate an ICS or 911 call per the post orders.
- E. The limits of Work shall be proposed and approved in writing prior to start. Confine operations to areas within agreed-upon limits of the Work. Work and access to the existing building outside the limits of Work will be strictly prohibited without advanced consent of the owner. The owner has the right to require any access to these areas to be 'Escorted Access' by the owner's staff. Should any work be required outside the limits of Work, the area is to be maintained in an occupiable condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.
- F. Site Access. The contractor's access shall be coordinated with the owner and Construction Manager and shall not be considered as 'Free Access'. The contractor shall provide a securable material storage trailer/container for placement outside of the secure fence area. Location of storage container/trailer shall be directed by the owner and Construction Manager.

1. Keep driveways, loading areas, entrances, etc. serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
- G. Vehicle Parking. Contractor vehicle parking will be in designated areas only. Vehicle access within the perimeter fence will be limited and shall be coordinated with the owner. Any vehicle within the secure perimeter shall be turned off and locked with all windows tightly closed and keys removed when not occupied. All materials, tools, or other loose items shall be secured when unattended. Vehicles, materials, tools, or loose items not meeting these requirements will be removed at the owner's expense.
- H. Dumpsters. The contractor is responsible for providing his own dumpsters, located where directed. The contractor shall schedule all dumpster removal times with the owner. Search of dumpsters may be done at any time at the discretion of the owner.
- I. Smoking anywhere on site is strictly prohibited.
- J. Lost Items. Any missing items including tools, phones, pagers, keys, etc. shall be reported to the owner immediately. The contractor shall not depart the facility until efforts are made to locate the misplaced or lost item.
- K. Facility Radio. The owner will assign a contact employee from the facility for the Contractor. One radio will be provided to the Contractor's designated person for communications. Use of and restrictions related to this radio will be outlined at the Security Orientation.
- L. Contractor Office. A typical contractor trailer will be allowed where directed by the Owner, outside of the secured facility perimeter. The contractor is to provide any desired furniture such as plan tables, chairs, file cabinets, etc. as needed. The contractor office shall be furnished to accommodate project meetings.
- M. Sanitary Facilities. Sanitary facilities shall be provided by the contractor and positioned at Owner designated locations.
- N. Electric Power Service. The owner will allow connections to circuits within the facility at no cost to the contractor. Where power is required, such as at the contractor's office, and available connection points are limited to utility owned systems, the contractor shall arrange and pay for his own temporary electric power service.
- O. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
- P. Fire Extinguishers. The contractor shall provide portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- Q. Data Services. The contractor shall provide any desired data access within their contractor's office. The owner will not allow access of any kind to their system. Any wireless system used shall be secured.
- R. Isolation of Work Area: Prevent dust, fumes, and odors from entering occupied areas.

1. Temporary shutdown of HVAC rooftop equipment for EPDM curb work shall be coordinated with the Owner for specific time periods. When courts are in session, these units must remain online unless otherwise agreed to by the Owner.
 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.
- S. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

1.6 WORK RESTRICTIONS

- A. Construction operations shall be limited to the hours between 7 AM and 5 PM weekdays. Weekend or holiday work shall be by written authorization from the Owner's representative in advance.
1. Permission may be granted for after-hours, weekend, or holiday construction operations if submitted in advance and approved. Submit requests for authorization no less than 72 hours prior to the requested period or more.
- B. Background checks for each person working within the facility will be required and performed by the owner. The successful contractor shall provide all personnel data required by the owner to perform this task not less than 21 days prior to the start of work. If an applicant has no criminal record, access will be granted. Should an applicant be found to have a criminal record sufficient to be deemed inappropriate for entry, access will not be granted. Any questions as to why the worker was denied access to the facility shall be made by the applicant to the Site Security Coordinator in writing. The General Contractor will be notified of those workers being approved and will work with sub-contractors to schedule those workers to attend a security orientation program which will provide an overview of the basic security practices they will be required to comply with during the construction.
1. Completion of the owner's Security Orientation program is required for all persons prior to working in the facility. This 2-hour program will be administered by the owner's designated person(s) and scheduled by the owner. A minimum of (2) sessions will be scheduled within the first (2) days of construction start. Additional sessions may be scheduled with the owner at the owner's discretion.
 2. No direct contact with the facility residents is allowed at any time. The Security Orientation program will provide further detail on this subject.
 3. A Special Visitor pass will be temporarily issued to persons who will be visiting or working on the construction site for a limited time to provide a service requiring a period not to exceed eight (8) hours to complete. Special Visitors will not be required to complete a criminal background consent form. Special Visitors will have access to the work area but will require a security escort whenever they are within the secure building/secure perimeter outside of the work area. Special Visitor passes are considered controlled security items. Hence, the Security Officer will obtain proper identification from the individual to whom the pass is to be issued. The Security Officer will retain the identification until the Special Visitors pass is returned. In addition, each pass recipient

will sign the Special Visitor Pass Log Book. This pass shall be worn above the waist in a clearly visible, conspicuous place by all visitors at all times.

4. When entering the secure building/secure perimeter, following identification and “sign-in” registration, workers will be screened with a hand-held metal detector. Carry-in items will be searched by security staff for contraband. Workers who require tools or other equipment to enter the facility will have all such equipment approved and inventoried on a form provided. Only those tools necessary to complete the contracted job are permitted inside the facility and must be inventoried by the assigned officer on the approved form upon entering and departing the facility. Through planning and scheduling the processing of tool documentation can be minimized and so are recommended.
5. Persons required to work outside of the ‘Work Area’ and within the Secure Facility Perimeter will always be escorted by facility staff and will be subject to tool control.

C. Tool Control

1. Due to the time-consuming nature of the inventory process and security concerns, contractors are encouraged to bring all required tools in at one time. A secure room will be provided by the owner for storage of tools. Any workers bringing tools into and out of the building daily will be detained for inventory procedures both entering and departing the site.
2. Categories of tools have been established to enable workers to effectively supervise all tools without unduly restricting the use of non-critical items. Although it is difficult to classify every specific tool in use in a facility, two general categories for tools are established, as follows:
 - a. Class A tools are items that can themselves be used as weapons or in an escape or can be used to fabricate weapons or facilitate escape.
 - b. Class B tools are those tools that have nominal weapons or escape facilitation potential.
3. Examples of items which are considered tools required to be stored and inventoried in accordance with this policy are as follows:
 - a. Scissors, shovels, rakes, ladders, extension cords (heavy duty type which in any way could be fashioned together for escape paraphernalia), ropes, hoses, etc.
 - b. Cutting tools. Security of specialty cutting tools for masonry and metals is critical. Therefore, the accountability of broken pieces of blades and bits is critical. Broken blade/bits pieces must be collected and returned to inventory to ensure the entire broken item is accounted for.
 - c. Freon and other aerosol containers will be considered Class “A” and will not be allowed to be stored in the secure building at any time.
 - d. Ladders or scaffolding shall be chained and padlocked to an immovable object when outside of the work area.

- e. Hilti gun (or similar) powder driven kits and charges will be stored in a specialty area and inventoried after each use. At no time will the Hilti gun or charges be approved for storage inside the secure building.
 - f. All flammable, hazardous, poisonous and toxic materials will be considered Class "A" items. This includes such items as gasoline, alcohol, acid, glue, insecticides, etc. These items shall be stored in a flammable storage cabinet or other suitable storage cabinet. All flammable and toxic materials, other than gasoline, will be stored in original containers. When original containers are not available the materials shall be in appropriate secondary use container properly labeled. The manufacturer's material Safety Data Sheets shall be maintained on all items within the storage areas. A copy of the material SDS shall also be maintained in the facility's Medical Unit. Gasoline and other flammables shall be strictly controlled. Gasoline shall not be stored or carried in any type of container except an approved safety can.
 - g. All excess oxygen, propane, acetylene, and other gas tanks (full or empty) shall be stored in a safe, secure, upright manner. Under no circumstances shall any gasoline, pressurized tanks, or mixing chambers be stored inside the secure building.
4. Weapons:
- a. Weapons are not allowed on site.

1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
- 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., 5days/week, unless otherwise indicated.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
- 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
- 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Controlled Substances: Use of tobacco products and other controlled substances on State Property is not permitted.

1.8 WELDING & CUTTING SAFETY (HOT WORK)

- A. Comply with 29 CFR 1910.252
- B. Contractor shall provide a safety work plan in strict accordance with all OSHA safety standards
- C. Definition: Welding/Hot Work: Any activity which results in sparks, fire, molten slag, or hot material which has the potential to cause fires or explosions. Examples of Hot Work include cutting, brazing, soldering, grinding, welding etc.
- D. Supervisors, Managers, and the Fire Safety Officer are responsible for ensuring the Hot Work Permit System is followed on all hot work performed at the institution.
- E. Hot Work Procedures
 - 1. Where practicable all combustibles will be relocated at least 35 feet from the work site.
 - 2. Where relocation is impractical, combustibles must be protected with flameproof covers, shielded with metal, guards, curtains, or wet down to help prevent ignition of material.
 - 3. Ducts, conveyor systems, and augers that might carry sparks to distant combustibles must be protected or shut down.
 - 4. Where cutting or welding is done near walls, partitions, ceilings, or a roof of combustible construction, fire-resistant shields or guards will be provided to prevent ignition.
 - 5. If welding is to be done on a metal wall, partition, ceiling, or roof, precautions must be taken to prevent ignition of combustibles on the other side, due to conduction or radiation of heat.
 - 6. Where combustibles cannot be relocated on the opposite side of the work, a fire watch person will be provided on the opposite side of the work.
 - 7. Cutting or welding on pipes or other metal in contact with combustible walls, partitions, ceilings, or roofs will not be undertaken if the work is close enough to cause ignition by combustion.
 - 8. In areas where there is dust accumulation of greater than 1/16 inch within 35 feet of the area where welding/hot works will be conducted, all dust accumulation will be cleaned up following the housekeeping program of the facility before welding/hot works are permitted.
 - 9. Suitable fire extinguishers must be provided and maintained ready for instant use.
 - 10. A fire watch will be provided during and for thirty minutes past the completion of the welding project. Patrols for two hours may be necessary under certain circumstances as specified by the Fire Safety Officer and/or the Plant Maintenance Engineer.
 - 11. A cutting/welding permit will be issued on all welding or cutting outside of designated welding areas.

12. Fire Protection

- a. Objects to be welded, cut or heated must be moved to a designated safe location. If the object cannot be easily moved, all moveable fire hazards will be moved or protected.
- b. If the object to be welded, cut, or heated cannot be moved and if all the fire hazards cannot be removed, positive means must be taken to confine the heat, sparks, and slag, and to protect the immovable fire hazards from them.
- c. Welding, cutting, or heating must not be performed in the presence of flammable paints, flammable compounds or heavy dust concentrations.
- d. Fire extinguishers must be immediately available in the work area, free of obstruction, and maintained for instant use.
- e. When normal fire prevention precautions are not sufficient for the welding, cutting, or heating operation the Fire Safety Officer and/or the Plant Maintenance Engineer will assign a fire watch. Sufficient amount of time must be allowed after completion of work to ensure that the possibility of fire does not exist. The designated fire watch must be trained in fire-fighting equipment.
- f. Gas supplies must be shut off during lunch breaks, overnight, or during shift breaks. Hoses and torches must be removed from confined spaces.

1.9 SCHEDULING

A. Contractor shall provide /proposed schedule, coordinated with the Owner's representative.

- | | |
|--|---------------|
| 1. Bids Due: | May 7, 2025 |
| 2. Estimated Start Date/Letter of Intent Issued: | May 26, 2025 |
| 3. Substantial Completion: | July 10, 2025 |
| 4. Final Completion: | July 31, 2025 |

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 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 the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.

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2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
1. Hangers. Include product data for components.
 2. Slotted support systems.
 3. Equipment supports.
 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
1. Include design calculations and details of hangers.
 2. Include design calculations for seismic restraints.

1.4 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. Suspended ceiling components.
 2. Ductwork, piping, fittings, and supports.
 3. Structural members to which hangers and supports will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Projectors.
- B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

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1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."
 2. Component Importance Factor: 1.5.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
 2. Self-extinguishing according to ASTM D 635.

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 inches o.c. in at least one surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-line, an Eaton business.
 - b. CADDY; a brand of nVent.
 - c. Thomas & Betts Corporation; A Member of the ABB Group.
 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.

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- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. 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, provide products by one of the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, [**zinc-coated**] [**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, provide products by one of the following:
 - 1) B-line, an Eaton business.
 - 2) 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 F 3125/F 3125M, **Grade A325**.
 - 6. Toggle Bolts: All-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.

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- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
 - 3. NECA 105.
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be **1/4 inch** in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted 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.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for **1-1/2-inch** and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, according to 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 shall be weight of supported components plus **200 lb.**

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- 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 inches** thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than **4 inches** 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 by means that comply with seismic-restraint strength and anchorage requirements.
- 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.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than **4 inches** larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use **3000-psi**, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

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C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of **2.0 mils**.
- B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
3. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

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- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Samples: For wireways nonmetallic wireways and surface raceways and for each color and texture specified, **12 inches** long.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: 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.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Calconduit.
 - d. O-Z/Gedney; a brand of Emerson Industrial Automation.

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2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: **0.040 inch**, minimum.
6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Calconduit.
 - d. O-Z/Gedney; a brand of Emerson Industrial Automation.
2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.
7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of **0.040 inch**, with overlapping sleeves protecting threaded joints.

- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

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2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Anamet Electrical, Inc.
 - c. Condux International, Inc.
 - d. Thomas & Betts Corporation; A Member of the ABB Group.
2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fiberglass:
 - a. Comply with NEMA TC 14.
 - b. Comply with UL 2515 for aboveground raceways.
 - c. Comply with UL 2420 for belowground raceways.
4. ENT: Comply with NEMA TC 13 and UL 1653.
5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
6. LFNC: Comply with UL 1660.
7. Rigid HDPE: Comply with UL 651A.
8. Continuous HDPE: Comply with UL 651A.
9. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
10. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Anamet Electrical, Inc.
 - c. Condux International, Inc.
 - d. Thomas & Betts Corporation; A Member of the ABB Group.
2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - a. Fittings for LFNC: Comply with UL 514B.

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4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. B-line, an Eaton business.
 2. Hoffman; a brand of nVent.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Allied Moulded Products, Inc.
 2. Hoffman; a brand of nVent.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

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2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. MonoSystems, Inc.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated.
 - b. MonoSystems, Inc.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crouse-Hinds, an Eaton business.
 - 2. EGS/Appleton Electric.
 - 3. Hoffman; a brand of nVent.
 - 4. Hubbell Incorporated.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

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- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing **50 lb**. Outlet boxes designed for attachment of luminaires weighing more than **50 lb** shall be listed and marked for the maximum allowable weight.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- J. Device Box Dimensions: **4 inches by 2-1/8 inches by 2-1/8 inches deep**.
- K. Gangable boxes are allowed.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- M. Cabinets:
 - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. NewBasis.

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c. Oldcastle Enclosure Solutions.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes **12 Inches Wide by 24 Inches Long** and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Underground Conduit: RNC, Type EPC-40-PVC.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.

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3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: **3/4-inch** trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds **120 deg F**.
- 3.2 INSTALLATION
- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
 - B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
 - C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
 - D. Do not fasten conduits onto the bottom side of a metal deck roof.

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- E. Keep raceways at least **6 inches** away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within **12 inches** of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within **12 inches** of enclosures to which attached.
- L. Raceways Embedded in Slabs:
 - 1. Run conduit larger than **1-inch** trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum **10-foot** intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of **2 inches** of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to GRC or IMC before rising above floor.
- M. Stub-Ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to **1-1/4-inch** trade size and insulated throat metal bushings on **1-1/2-inch** trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

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- Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- S. Cut conduit perpendicular to the length. For conduits **2-inch** trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **200-lb** tensile strength. Leave at least **12 inches** of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- U. Surface Raceways:
 - 1. Install surface raceway with a minimum **2-inch** radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding **48 inches** and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- V. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all 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 raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.
 - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Y. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed **30 deg F** and that has straight-run length that exceeds **25 feet**. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed **100 deg F** and that has straight-run length that exceeds **100 feet**.

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2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. 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.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- AA. 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.
- BB. 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.
- CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- DD. Locate boxes so that cover or plate will not span different building finishes.
- EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- GG. Set metal floor boxes level and flush with finished floor surface.
- HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

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3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than **6 inches** in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within **12 inches** of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with **3 inches** of concrete for a minimum of **12 inches** on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of **60 inches** from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from **1/2-inch** sieve to **No. 4** sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures **1 inch** above finished grade.
- D. Install handholes with bottom below frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

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- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 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

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SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than **50 inches** and with no side larger than **16 inches**, thickness shall be **0.052 inch**.

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- b. For sleeve cross-section rectangle perimeter **50 inches** or more and one or more sides larger than **16 inches**, thickness shall be **0.138 inch**.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 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. [Advance Products & Systems, Inc.](#)
 - b. [CALPICO, Inc.](#)
 - c. [Metraflex Company \(The\).](#)
 - d. [Pipeline Seal and Insulator, Inc.](#)
 - e. [Proco Products, Inc.](#)
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 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. [Presealed Systems.](#)

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: **5000-psi**, 28-day compressive strength.

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- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Cables Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07.
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide **1/4-inch** annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors **2 inches** above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Cables Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

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2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they 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 sleeve-seal fittings.

END OF SECTION 260544

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SECTION 260548 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Restraint channel bracings.
- 2. Restraint cables.
- 3. Seismic-restraint accessories.
- 4. Mechanical anchor bolts.
- 5. Adhesive anchor bolts.

B. Related Requirements:

- 1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.

- 1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.

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- a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- 3. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For professional engineer.
- C. Welding certificates.
- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

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- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. See Structural Design.
B. The following components are $I_p = 1.5$:
1. Fire alarm system
 2. Generator and emergency power distribution system.

2.2 RESTRAINT CHANNEL BRACINGS

- 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 B-Line, Inc.; a Division of Cooper Industries.](#)
 2. [Hilti, Inc.](#)
 3. [Mason Industries, Inc.](#)
 4. [Unistrut; Atkore International.](#)
- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. [Kinetics Noise Control, Inc.](#)
 2. [Loos & Co., Inc.](#)
 3. [Vibration Mountings & Controls, Inc.](#)
- B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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1. [Cooper B-Line, Inc.; a Division of Cooper Industries.](#)
2. [Kinetics Noise Control, Inc.](#)
3. [Mason Industries, Inc.](#)
4. [TOLCO; a brand of NIBCO INC.](#)

B. Hanger-Rod Stiffener:

1. Steel tube or steel slotted-support-system sleeve with internally bolted connections.
2. Reinforcing steel angle clamped to hanger rod.

- C. Hinged and Swivel Brace Attachments:** Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts:** Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage:** Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings:** One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

- 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 B-Line, Inc.; a Division of Cooper Industries.](#)
 2. [Hilti, Inc.](#)
 3. [Kinetics Noise Control, Inc.](#)
 4. [Mason Industries, Inc.](#)
- B. Mechanical Anchor Bolts:** Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.6 ADHESIVE ANCHOR BOLTS

- A. Manufacturers:** Subject to compliance with requirements, provide products by the following:
1. [Hilti, Inc.](#)
 2. [Kinetics Noise Control, Inc.](#)
 3. [Mason Industries, Inc.](#)
- B. Adhesive Anchor Bolts:** Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive.

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Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03.
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds **0.125 inch**.
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

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F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.

B. Seismic controls will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

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3.6 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for conductors.
 - 2. Underground-line warning tape.
 - 3. Warning labels and signs.
 - 4. Equipment identification labels.
 - 5. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

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- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than **3 mils** thick by **1 to 2 inches** wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, **3-mil**-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- F. Write-On Tags: Polyester tag, **0.015 inch** thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

2.2 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 4. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

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5. Thickness: 4 mils.
6. Weight: 18.5 lb/1000 sq. ft..
7. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 2. 1/4-inch grommets in corners for mounting.
 3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
 2. 1/4-inch grommets in corners for mounting.
 3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD."

2.4 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

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- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch**.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch**. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be **3/8 inch**.
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be **3/8 inch**.

2.6 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: **3/16 inch**.
 - 2. Tensile Strength at **73 deg F**, According to ASTM D 638: **12,000 psi**.
 - 3. Temperature Range: **Minus 40 to plus 185 deg F**.
 - 4. Color: Black except where used for color-coding.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

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- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at **6 to 8 inches** below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds **16 inches** overall.

3.2 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of **6 inches** from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- B. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.
- C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

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- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.
- F. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 - 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Enclosed switches.

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- e. Enclosed circuit breakers.
- f. Enclosed controllers.

END OF SECTION 260553

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SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section..

1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

- A. One-Line Diagram: A diagram which 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.
- B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- C. SCCR: Short-circuit current rating.
- D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.
 - 1. Short-circuit study input data, including completed computer program input data sheets.
 - 2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the 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 the selection of devices and associated characteristics is satisfactory.

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- b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Short-Circuit Study Specialist
- B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

- A. Software Developers: Subject to compliance with requirements, provide software by one of the following:
 - 1. ESA Inc
 - 2. Operation Technology, Inc.
 - 3. Power Analytics, Corporation.
 - 4. SKM Systems Analysis, Inc.
- B. Comply with IEEE 399 and IEEE 551.
- C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

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2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Comments and recommendations for system improvements, where needed.
- E. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 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 the 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: As described in "Power System Data" Article in the Evaluations.
- G. Short-Circuit Study Output:
 - 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:

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- 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 a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Obtain all data necessary for the conduct of the study.
 1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
 2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 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 the 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.

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5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
 1. Electric utility's supply termination point.
 2. Incoming switchgear.
 3. Unit substation primary and secondary terminals.
 4. Low-voltage switchgear.

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5. Motor-control centers.
6. Control panels.
7. Standby generators and automatic transfer switches.
8. Branch circuit panelboards.
9. Disconnect switches.

3.3 ADJUSTING

- A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

- A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260572

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SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

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 computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1.3 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 which 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. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and equipment evaluation reports.
 - 3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

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- a. Submit study report for action prior to receiving final approval of the 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 the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Coordination Study Software Developer Coordination Study Specialist.
- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. The following parts from the Protective Device Coordination Study Report:
 - 1) One-line diagram.
 - 2) Protective device coordination study.
 - 3) Time-current coordination curves.
 - b. Power system data.

1.7 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All

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elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. **Software Developers:** Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:
1. [ESA Inc.](#)
 2. [Operation Technology, Inc.](#)
 3. [Power Analytics, Corporation.](#)
 4. [SKM Systems Analysis, Inc.](#)
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall 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.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
1. Protective device designations and ampere ratings.
 2. Cable size and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.

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5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study – Refer to Section 260572 – “Overcurrent Protective Device Short-Circuit Study”.
- F. Protective Device Coordination Study:
 1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the 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, ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
 - c. Fuses: Show current rating, voltage, and class.
 - G. 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 the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 3. Identify the 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- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - c. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.

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- d. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - e. Cables and conductors damage curves.
 - f. Ground-fault protective devices.
 - g. Motor-starting characteristics and motor damage points.
 - h. Generator short-circuit decrement curve and generator damage point.
 - i. The largest feeder circuit breaker in each motor-control center and panelboard.
- 5. Provide adequate time margins between device characteristics such that selective operation is achieved.
 - 6. 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. 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 PROTECTIVE DEVICE 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. The study shall be based on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Motor Protection:

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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 the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- I. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.
- J. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- K. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
1. Electric utility's supply termination point.
 2. Low-voltage Switchboards.
 3. Standby generators and automatic transfer switches.
 4. Branch circuit panelboards.
- L. 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. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the overcurrent protective device study.
1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
 2. For new equipment, use characteristics submitted under the 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

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engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

- B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 241 and IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
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 the service.
 3. Power sources and ties.
 4. Short-circuit current at each system bus, three phase and line-to-ground.
 5. Voltage level at each bus.
 6. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 7. 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.
 8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 9. Motor horsepower and NEMA MG 1 code letter designation.
 10. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
 11. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
 12. Data sheets to supplement electrical distribution system 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 rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

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- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
- k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.4 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.5 DEMONSTRATION

- A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:
 1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
 2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
 3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573

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SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 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 which 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. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
 - 1. Arc-flash study input data, including completed computer program input data sheets.
 - 2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in

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equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Arc-Flash Study Specialist.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
- B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:

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1. [ESA Inc.](#)
2. [Operation Technology, Inc.](#)
3. [Power Analytics, Corporation.](#)
4. [SKM Systems Analysis, Inc.](#)

B. Comply with IEEE 1584 and NFPA 70E.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENT

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
 1. Protective device designations and ampere ratings.
 2. Cable size and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output:
 1. 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 a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- F. 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. Working distance.
 6. Incident energy.
 7. Hazard risk category.
 8. Recommendations for arc-flash energy reduction.

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- G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a **3.5-by-5-inch** thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1. Location designation.
 - 2. Nominal voltage.
 - 3. Flash protection boundary.
 - 4. Hazard risk category.
 - 5. Incident energy.
 - 6. Working distance.
 - 7. Engineering report number, revision number, and issue date.
- C. Labels shall 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 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.

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- E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
 - 1. Electric utility's supply termination point.
 - 2. Switchgear.
 - 3. Low-voltage switchgear.
 - 4. Motor-control centers.
 - 5. Standby generators and automatic transfer switches.
 - 6. Branch circuit panelboards.

3.3 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

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- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the 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.

3.4 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
 - 1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
 - 2. Use characteristics submitted under the provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 - 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 at the service.
 - 3. Power sources and ties.
 - 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
 - 5. For reactors, provide manufacturer and model designation, voltage rating and impedance.
 - 6. 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.

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7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
9. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. Motor horsepower and NEMA MG 1 code letter designation.
11. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
12. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.5 LABELING

- A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
 1. Low-voltage switchboard.
 2. Switchgear.
 3. Control panel.

3.6 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.7 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

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SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

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 Cx process requirements for the following electrical components, systems, assemblies, and equipment:

- 1. Electrical equipment connected to Normal power systems, including the following:

- a. Transformers.
- b. Stand-by power generator
- c. Automatic Transfer Switches
- d. Primary and secondary service electrical systems.
- e. Distribution and branch-circuit panelboards.
- f. Lightning protection systems.
- g. Grounding systems.

- 2. Electrical equipment connected to Essential power systems that provide an alternative source of power in the absence of power from the Normal power system, including the following:

- a. Secondary service electrical systems.
- b. Distribution and branch-circuit panelboards.
- c. Automatic Transfer Switches
- d. Manual Transfer Switches (Storm Switch)
- e. Lighting protection systems.
- f. Grounding systems.
- g. Stand-by power generator
- h. Emergency egress lighting systems and illuminated exit signs
- i. Emergency egress lighting inverters.

- 3. Controls and instrumentation, including the following:

- a. Equipment monitoring systems.
- b. Energy monitoring and control systems.
- c. Electrical metering and metering system.
- d. Demand response systems.
- e. Lighting control systems.

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- f. Security systems.
 - g. Fire-alarm systems.
- 4. Systems testing and verification, including Normal and Essential power systems, and transitions from Normal to Essential power systems and back.
- B. Related Requirements:
 - 1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.

1.3 DEFINITIONS

- A. BoD: Basis-of-Design Document, as defined in Section 019113 "General Commissioning Requirements."
- B. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."
- C. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- D. Essential Power Systems: A power system that a facility transitions to in the absence of Normal power. This power includes all systems classified as "standby" or "emergency," including "legally required."
- E. Low Voltage: 600 V and below.
- F. Medium Voltage: 601 V and above.
- G. Normal Power Systems: A power system that provides primary power to a facility.
- H. OPR: Owner's Project Requirements, as defined in Section 019113 "General Commissioning Requirements."
- I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For BAS and electrical testing technician.
- B. Construction Checklists: Draft construction checklists will be created by CxA for Contractor review.
- C. Construction Checklists: Include the following and comply with requirements in Section 019113 "General Commissioning Requirements" for construction checklists:

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1. Instrumentation and control for electrical systems.
2. Instrumentation and control for lighting control systems.
3. Low-voltage power cables.
4. Control voltage power cables.
5. Electrical feeders and branch circuits.
6. Liquid-filled transformers.
7. Dry-type transformers.
8. Instrument transformers.
9. Switchgear and switchboard assemblies rated 1200 A or greater.
10. Low-voltage motor starters.
11. Low-voltage air circuit breakers.
12. Low-voltage insulated case circuit breakers.
13. Low-voltage network protectors.
14. Low-voltage air switches.
15. Low-voltage surge protective devices.
16. Medium-voltage power cables.
17. Metering devices.
18. Molded-case circuit breakers.
19. Low-voltage power circuit breakers.
20. Grounding systems.
21. Ground-fault protection systems.
22. Panelboards.
23. Receptacles and devices.
24. Engine generators.
25. Automatic transfer switches.
26. Variable-frequency drives.
27. AC synchronous motors and generators.
28. AC induction motors and generators.
29. Battery systems.
30. Battery chargers.
31. Flooded lead-acid batteries.
32. Flooded lead-calcium batteries.
33. VRLA batteries.
34. UPS and Emergency Lighting inverter systems.
35. Lighting.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electrical systems and components to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Testing Technician Qualifications: Technicians to perform electrical Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:

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1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate's degree in electrical systems, or similar field. Degree may be offset by three years' experience as an apprentice or a journey-level electrician. Generally, required knowledge includes electrical and HVAC&R concepts, building operations, and application and use of tools and instrumentation to measure performance of electrical equipment, assemblies, and systems.
 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:
1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
 - a. Equipment/instrument identification number.
 - b. Planned Cx application or use.
 - c. Manufacturer, make, model, and serial number.
 - d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
 2. Test equipment and instrumentation shall meet the following criteria:
 - a. Capable of testing and measuring performance within the specified acceptance criteria.
 - b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
 - c. Be maintained in good repair and operating condition throughout duration of use on Project.
 - d. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- C. Proprietary Test Instrumentation and Tools:
1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:
 - a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:
 - 1) Instrument or tool identification number.
 - 2) Equipment schedule designation of equipment for which the instrument or tool is required.
 - 3) Manufacturer, make, model, and serial number.
 - 4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

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- b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
- c. Electrical proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

- A. Prepare detailed construction checklists for electrical systems, subsystems, equipment, and components. Complete and submit construction checklists.

3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.
- B. Return draft Construction Checklist review comments within 10 days of receipt.
- C. When review comments have been resolved, CxA will provide final construction checklists, marked "Approved for Use, (date)."
- D. Use only construction checklists, marked "Approved for Use, (date)."

3.3 GENERAL TESTING REQUIREMENTS

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.
- B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

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- E. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.
- F. Construction Checklists: Prepare and submit detailed construction checklists for electrical systems, subsystems, equipment, and components.
 - 1. Contributors to development of construction checklists shall include, but are not limited to, the following:
 - a. Electrical systems and equipment installers.
 - b. Electrical instrumentation and controls installers.
- G. Perform tests using design conditions, whenever possible.
 - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
 - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
 - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.
- I. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- J. Coordinate schedule with, and perform Cx activities at the direction of the CxA.
- K. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Sections specifying electrical systems and equipment.
- L. Provide technicians, instrumentation, tools, and equipment to complete and document the following:
 - 1. Performance tests.
 - 2. Demonstration of a sample of performance tests.
 - 3. Cx tests.
 - 4. Cx test demonstrations.

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3.4 Cx TESTS FOR ELECTRICAL SYSTEMS

A. Verification of Normal Power System Operation:

1. Prerequisites: Acceptance of results for construction checklists for Division 26 electrical components associated with Normal power system.
2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
3. Test Purpose: Verify operation of Normal power system.
4. Test Conditions: Energize components of Normal power system, one at a time.
5. Acceptance Criteria: Proper operation of Normal power system over a 48-hour period.

B. Verification of Essential Power System Operation:

1. Prerequisites:
 - a. Acceptance of results for construction checklists for Division 26 electrical components associated with Essential power system.
 - b. Completion of "Verification of Normal Power System Operation" tests.
2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
3. Test Purpose: Verify operation of Essential power system.
4. Test Conditions:
 - a. Energize components of Normal power system.
 - b. Simulate a failure of Normal power system.
5. Acceptance Criteria: Transfer of power from Normal to Essential power system within OPR.

C. Verification of Control and Instrumentation:

1. Prerequisites: Acceptance of results for construction checklists.
 - a. Section 260913 "Electrical Power Monitoring and Control."
 - b. Section 260926 "Lighting Control Panelboards."
 - c. Section 260936 "Modular Dimming Controls."
 - d. Section 260943.16 "Addressable-Luminaire Lighting Controls."
 - e. Section 260943.23 "Relay-Based Lighting Controls."
 - f. Section 262713 "Electricity Metering."
 - g. Section 263533 "Power Factor Correction Equipment."

D. Test Purpose: Verify operation of control and monitoring systems for Normal and Essential power systems.

E. Test Conditions:

1. Energize components of Normal power system.
2. Test operation of equipment.

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F. Acceptance Criteria: Operation of equipment according to OPR.

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SECTION 260923 - LIGHTING CONTROL DEVICES

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. Photoelectric switches.
 - 2. Indoor occupancy sensors.
 - 3. Lighting contactors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC 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:

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1. [Cooper Industries, Inc.](#)
2. [Intermatic, Inc.](#)
3. [NSi Industries LLC; TORK Products.](#)
4. [Tyco Electronics; ALR Brand.](#)

B. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: **1.5 to 10 fc**, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Lightning Arrester: Air-gap type.

2.2 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. [Bryant Electric; a Hubbell company.](#)
2. [Cooper Industries, Inc.](#)
3. [Hubbell Building Automation, Inc.](#)
4. [Leviton Mfg. Company Inc.](#)
5. [Lithonia Lighting; Acuity Lighting Group, Inc.](#)
6. [Lutron Electronics Co., Inc.](#)
7. [Sensor Switch, Inc.](#)
8. [Square D; a brand of Schneider Electric.](#)

B. General Requirements for Sensors: Ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a **1/2-inch** knockout in a standard electrical enclosure.

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- c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 - 7. Bypass Switch: Override the "on" function in case of sensor failure.
 - 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
- 1. Sensitivity Adjustment: Separate for each sensing technology.
 - 2. 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. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.3 LIGHTING CONTACTORS

- 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. [Allen-Bradley/Rockwell Automation.](#)
 - 2. [ASCO Power Technologies, LP; a division of Emerson Electric Co.](#)
 - 3. [Eaton Corporation.](#)
 - 4. [General Electric Company; GE Consumer & Industrial - Electrical Distribution; Total Lighting Control.](#)
 - 5. [Square D; a brand of Schneider Electric.](#)
- B. Description: Electrically operated and mechanically held, combination-type lighting contactors complying with NEMA ICS 2 and UL 508.
- 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.
 - 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.
 - 5. Where two-wire maintained switch control is indicated, provide solid-state control modules as required for indicated switching arrangement.

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2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 16 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 No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. 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.
- B. 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 written instructions.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is **1/2 inch**.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

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1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following 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.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.6 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943 "Network Lighting Controls."

B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

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SECTION 262416 - PANELBOARDS

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. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS (SPD): Transient voltage surge suppressor.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. 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. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.
 - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.

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1.5 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

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. Keys: Two spares for each type of panelboard cabinet lock.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. 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.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

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1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards.
- B. Handle and prepare panelboards for installation according to NECA 407.

1.10 PROJECT CONDITIONS

A. Environmental Limitations:

- 1. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding **minus 22 deg F** to **plus 104 deg F**.
 - b. Altitude: Not exceeding **6600 feet**.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

- 1. Ambient temperatures within limits specified.
- 2. Altitude not exceeding **6600 feet**.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

- 1. Notify Owner no fewer than five days in advance of proposed interruption of electric service.
- 2. Do not proceed with interruption of electric service without Owner's written permission.
- 3. Comply with NFPA 70E.

1.11 COORDINATION

- A. 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.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

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1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets as indicated on the drawings.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 3. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel or Same finish as panels and trim.
 - 4. Directory Card: Inside panelboard door, mounted in transparent card holder
- C. Incoming Mains Location: Top or bottom to match feeder locations.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

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4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
- I. Selective Coordination: Provide overcurrent protective devices that selective coordinate in accordance with code requirements.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. Surge Suppression (SPD/TVSS): Provide factory installed SPD's as an integral part of, as a minimum, new distribution panels, new panelboards serving dorm room loads, in panels as required by NEC 215.18 and any other panels indicated on plans, complying with UL 1449 SPD Type 2.

2.3 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. Square D; a brand of Schneider Electric
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Lugs only as scheduled.

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- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Square D; a brand of Schneider Electric
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only as scheduled.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

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4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip). Provided where indicated on plan or required in accordance with the NEC.
5. AFCI Circuit Breakers: provided where indicated on plan or as required for apartment circuits in accordance with the NEC for apartment (residential) load centers and panelboards.
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip). Provided where indicated on plan or required in accordance with the NEC.
7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at percent of rated voltage.
 - e. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - f. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - g. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - h. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

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- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.
- B. Mount top of trim **90 inches** above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four **1-inch** empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four **1-inch** empty conduits into raised floor space or below slab not on grade.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

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3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 262416

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SECTION 262726 - WIRING DEVICES

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. Straight-blade convenience, receptacles.
2. GFCI receptacles
3. AFCI receptacles
4. Tamper-resistant receptacles
5. Twist-locking receptacles.
6. Cord and plug sets.
7. Toggle switches.
8. Wall switch sensor light switches with dual technology sensors.
9. Wall plates.

1.3 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

B. EMI: Electromagnetic interference.

C. GFCI: Ground-fault circuit interrupter.

D. AFCI: Arc-fault circuit interrupter

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

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1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.
- D. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

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- F. Provide device boxes installed in exterior walls with a nail-on flanged vapor box (including ground clip) for each receptacle or switch (single and multi-ganged device boxes) for minimizing air infiltration (Arlington No. FN101FLGC and FN102FLGC or equal).

2.2 STRAIGHT-BLADE RECEPTACLES

- A. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with AFCI and GFCI Device:
 - 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. General Characteristics:
 - a. Reference Standards: UL CCN KCXX, UL 498, UL 943, UL 1699, and UL Subject 1699A.
 - 3. Options:
 - a. Device Color: As indicated on architectural Drawings.
 - b. Configuration: Heavy-duty, NEMA 5-20R.
 - 4. 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 wall plate finish.

2.3 GFCI RECEPTACLES

- A. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
 - 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. General Characteristics:
 - a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.

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3. Options:

- a. Device Color: As indicated on architectural Drawings.
- b. Configuration: Heavy-duty, NEMA 5-20R.

4. 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 wall plate finish.

2.4 TWIST-LOCKING RECEPTACLES

- A. Twist-Lock, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

2.5 CORD AND PLUG SETS

A. Description:

- 1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- 2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- 3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:

- 1. Single Pole
- 2. Two Pole
- 3. Three Way
- 4. Four Way

- C. Pilot-Light Switches: 120/277 V, 20 A.

- 1. Description: Single pole, with LED-lighted handle, illuminated when switch is off.

- D. Key-Operated Switches: 120/277 V, 20 A.

- 1. Description: Single pole, with factory-supplied key in lieu of switch handle.

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2.7 WALL SWITCH SENSOR LIGHT SWITCH, DUAL TECHNOLOGY

- A. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual technology.
1. Connections: Hard wired.
 2. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 hp at 120-V ac.
 3. Adjustable time delay of five to 30 minutes.
 4. Able to be locked to Automatic-On or Manual-On mode as directed by Owner.
 5. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
 6. Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.8 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.9 FINISHES

- A. Device Color:
1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to panels that are not connected to the UPS system: Identify using a separate color to be selected by Owner.
- B. Wall Plate Color: Gray for plastic covers.
- C. Final color selection for devices and device plates shall be confirmed or directed by the architect.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. ADA apartment unit device mounting heights:
 - 1. Applicable to all receptacles, light control devices and load center circuit breakers
 - 2. Maximum allowed mounting height to top of receptacle box, top of light control device box or top of circuit breaker toggle is 48" AFF.
 - 3. Minimum allowed mounting height to bottom of receptacle box, bottom of light control device box or bottom of circuit breaker toggle is 15" AFF
- C. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- D. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.
- E. Device Installation:
 - 1. AFCI, GFCI and combination AFCI/GFCI circuit breakers are acceptable substitutions for serving circuits in locations where AFCI and GFCI receptacles are required.
 - 2. GFCI receptacle resets must be in accessible locations as defined by the electrical code.; locate respective GFCI receptacle accordingly, utilize remote GFCI reset devices or utilize GFCI circuit breakers.

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3. Provide AFCI devices (or circuit breakers) for all devices located in residential units and any other areas as required by the electrical code.
 4. Provide GFCI devices (or circuit breakers) for all devices located bathroom, kitchen, laundry, outdoors, garages, accessory buildings, sheds, crawl spaces or basement areas and any other areas as required by the electrical code.
 5. General grade device installations shall be permitted in back of house spaces and staff support spaces that will not be accessed, occupied or utilized by residents. (eg. electrical rooms, mechanical rooms, tel/com rooms, commercial kitchen commercial laundry, attics and roof)
 6. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 7. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 8. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 9. Connect devices to branch circuits using pigtails that are not less than **6 inches** in length.
 10. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 11. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 12. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 13. Tighten unused terminal screws on the device.
 14. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- F. Receptacle Orientation: Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
- G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- J. Envelope integrity and sound transmission:
1. Provide device boxes mounted on exterior walls with Energy Star rated receptacle box vapor barrier; Thomas & Betts, Nutek or equal.
 2. Provide device plate gaskets for boxes mounted on exterior walls with Energy Star rated device gasket; Hubbell, Madison Electric or equal
 3. Utilize fire stop sealant around conduit penetrations to aid with minimizing the sound transmission between each unit and between units and common space
 4. Utilize wall insulation material and device plate gaskets to aid with minimizing the sound transmission between each unit and between units and common space.

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5. Do not install devices back-to-back in walls between units; shift the devices so that they are installed one horizontal stud bay away from each other when mounted on common walls between units

3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 1. Test Instruments: Use instruments that comply with UL 1436.
 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Convenience Receptacles:
 1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

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- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 262726

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SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, and enclosed controllers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified Division 01, include the following:

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1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than **40 deg F** or more than **100 deg F**, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.8 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

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. Cooper Bussmann, Inc.
 2. Edison Fuse, Inc.
 3. Ferraz Shawmut, Inc.

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4. [Littelfuse, Inc.](#)

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Feeders: Class RK1, time delay or Class RK5, time delay.
 - 2. Motor Branch Circuits: Class RK5, time delay.
 - 3. Other Branch Circuits: Class RK1, time delay or Class RK5, time delay.
 - 4. Control Circuits: Class CC, time delay.
- B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

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3.3 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Shunt trip switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Molded-case switches.
 - 6. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

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1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

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1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source 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 as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than **minus 22 deg F** and not exceeding **104 deg F**.
 - 2. Altitude: Not exceeding **6600 feet**.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than five days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

1.10 COORDINATION

- A. 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.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

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1. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac as appropriate for circuit voltage, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, 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. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 4. Lugs: Mechanical type, suitable for number, size, and conductor material.
 5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 1. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, -240 or 600-V ac as appropriate for circuit voltage, 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. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 1. Square D; a brand of Schneider Electric.

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- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 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^2t response.
- D. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- E. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- F. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- G. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - 8. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

2.4 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Square D; a brand of Schneider Electric.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

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C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X.

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.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.3 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.

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3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. 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.

END OF SECTION 262816

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SECTION 262913 - ENCLOSED 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 the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified"

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1.5 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.
- C. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- D. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:
 - 1. Routine maintenance requirements for enclosed controllers and installed components.

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2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than **minus 22 deg F** and not exceeding **104 deg F**.
 2. Altitude: Not exceeding **6600 feet**.
- B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Owner no fewer than five days in advance of proposed interruption of electrical systems.
 2. Indicate method of providing temporary utilities.
 3. Do not proceed with interruption of electrical systems without Owner's written permission.
 4. Comply with NFPA 70E.

1.11 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

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PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Eaton Electrical Inc.; Cutler-Hammer Business Unit.](#)
 - b. [General Electric Company; GE Consumer & Industrial - Electrical Distribution.](#)
 - c. [Rockwell Automation, Inc.; Allen-Bradley brand.](#)
 - d. [Siemens Energy & Automation, Inc.](#)
 - e. [Square D; a brand of Schneider Electric.](#)
 - 2. Configuration: Nonreversing.
 - 3. Surface mounting.
 - 4. Red pilot light.
- C. Magnetic Controllers: Full voltage, across the line, electrically held.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Eaton Electrical Inc.; Cutler-Hammer Business Unit.](#)
 - b. [General Electric Company; GE Consumer & Industrial - Electrical Distribution.](#)
 - c. [Rockwell Automation, Inc.; Allen-Bradley brand.](#)
 - d. [Siemens Energy & Automation, Inc.](#)
 - e. [Square D; a brand of Schneider Electric.](#)
 - 2. Configuration: Nonreversing
 - 3. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

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5. Control Circuits: 120-V ac maximum; obtained from integral CPT, with primary and secondary fuses, of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 100 VA.
6. Melting Alloy Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 20 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
7. Bimetallic Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 20 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
8. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 20 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
9. N.O., isolated overload alarm contact.
10. External overload reset push button.
- D. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 2. Fusible Disconnecting Means:

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- a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
4. MCP Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
 - d. N.O. alarm contact that operates only when MCP has tripped.
 - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
5. MCCB Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
 - e. N.O. alarm contact that operates only when MCCB has tripped.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 1. Dry and Clean Indoor Locations: Type 1.
 2. Outdoor Locations: Type 3R
 3. Other Wet or Damp Indoor Locations: Type 4X.

2.3 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: Heavy-duty, type.

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- a. Push Buttons: Recessed types; momentary.
 - b. Pilot Lights: LED types; colors as indicated; push to test.
 - c. Selector Switches: Rotary type Hand-off-automatic for units with remote automatic control; on-off for units with only local control.
- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- D. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise 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."
- B. Seismic Bracing: Comply with requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Install fuses in each fusible-switch enclosed controller.
- D. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

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- G. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

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- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.
- D. Set field-adjustable circuit-breaker trip ranges.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers

END OF SECTION 262913

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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 LED luminaires and luminaire supports.
- 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.
 - 2. Section 260943.16"Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
 - 3. Section 260100 "Basic Electrical requirements" for Efficiency Maine lighting fixture and lighting control rebate program participation and support efforts shall be included in this project's scope of work.

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.

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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 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 and IES LM-80.
 - 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. Samples for Verification: as requested during submittal review.
 - 1. Include Samples of luminaires and accessories to verify finish selection.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- B. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Product Certificates: For each type of luminaire.
- D. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Sample warranty.

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1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. In addition to the quantity of fixtures required to complete the project, furnish a quantity of 5% extra for each fixture type. Furnish at least one of each type.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: 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.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE 7.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

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. Standards:

1. ENERGY STAR certified or listed by the DesignLights Consortium (DLC).
2. UL Listing: Listed for damp location.
3. Recessed luminaires shall comply with NEMA LE 4.
4. User Replaceable Lamps:

- a. Bulb shape complying with ANSI C78.79.
- b. Lamp base complying with ANSI C81.61 or IEC 60061-1.

- C. Rated lamp life of 50,000 hours to L70.

- D. Lamps dimmable from 100 percent to 1 percent of maximum light output.

- E. Internal driver. For luminaires indicated for individually addressable control, provide individually addressable DALI drivers that are compatible with the system specified in Section 260943.16 "Addressable Luminaire Lighting Controls".

- F. Nominal Operating Voltage: As scheduled on the drawings.

1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.3 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.

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- B. 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.
- C. 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. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least **0.125 inch** minimum unless otherwise indicated.
- D. 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 for all luminaires.

2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 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 A 641/A 641 M, Class 3, soft temper, zinc-coated steel, **12 gauge**.
- D. Rod Hangers: **3/16-inch** minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. 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 vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
 - 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 Luminaire Support:
 - 1. Attached to structural members in walls or attached to a minimum 20 gauge backing plate attached to wall structural members.
 - 2. Do not attach luminaires directly to gypsum board.

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G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two **5/32-inch**-diameter aircraft cable supports adjustable to **120 inches** in length.
2. Ceiling mount with pendant mount with **5/32-inch**-diameter aircraft cable supports adjustable to **120 inches** in length.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than **48 inches**, 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. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. 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.

J. 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.

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3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

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SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

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. RS-232 cabling.
 - 2. RS-485 cabling.
 - 3. Low-voltage control cabling.
 - 4. Control-circuit conductors.
 - 5. Fire alarm wire and cable.
 - 6. Identification products.

1.3 RELATED SECTIONS

- A. Network cabling shall comply with Division 27.

1.4 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.

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1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.7 FIELD CONDITIONS

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
 - 1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, **3/4 by 48 by 96 inches**. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

2.3 RS-232 CABLE

- A. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Plastic insulation.
 - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 - 4. Plastic jacket.
 - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - 6. Flame Resistance: Comply with NFPA 262.

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2.4 RS-485 CABLE

- A. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Fluorinated ethylene propylene insulation.
 - 3. Unshielded.
 - 4. Fluorinated ethylene propylene jacket.
 - 5. Flame Resistance: NFPA 262, Flame Test.

2.5 LOW-VOLTAGE CONTROL CABLE

- A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 - 1. One pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with NFPA 262.

2.6 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Copper, Type THHN-THWN, complying with UL 83, in raceway or MC cable as specified in Part 3.
- B. Class 2 Control Circuits: Stranded copper, power-limited cable, complying with UL 83, concealed in building finishes. Install cable in metal raceways where specified in Part 3.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83. Install cable in metal raceways where specified in Part 3.

2.7 FIRE ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. [Comtran Corporation](#).
 - 2. [Draka Cableteq USA](#).
 - 3. [Genesis Cable Products; Honeywell International, Inc.](#)
 - 4. [West Penn Wire](#).
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

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C. Signaling Line Circuits:

1. Twisted, shielded pair in metal raceway, size as recommended by system manufacturer but not less than No. 18 AWG.
2. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated..

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated.

2.8 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. [Brady Worldwide, Inc.](#)
2. [Kroy LLC.](#)
3. [Panduit Corp.](#)

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.2 WIRING METHOD

A. Install cable, concealed in accessible ceilings, and walls in finished areas.

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- B. Install wiring in metal pathways and wireways where exposed in mechanical rooms and at exposed structural ceilings.
 - 1. Minimum conduit size shall be ½-inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
- C. Wiring within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 - 2. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
 - 3. Install conductors parallel with or at right angles to sides and back of enclosure.
 - 4. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks.
 - 5. Mark each terminal according to system's wiring diagrams.
 - 6. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. General Requirements for Cabling:
 - 1. 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.
 - 2. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 3. 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.
 - 4. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
- D. Open-Cable Installation:
 - 1. Suspend copper cable not in a wireway or pathway a minimum of **8 inches** above ceilings by cable supports not more than **60 inches** apart.
 - 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

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3.4 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
- C. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: **1-inch** conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

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3.6 CONNECTIONS

- A. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System for connecting, terminating, and identifying wires and cables.

3.7 FIRESTOPPING

- A. Comply with requirements in Division 07.

3.8 GROUNDING

- A. For low-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.9 IDENTIFICATION

- A. Identify system components, wiring, and cabling. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
- B. Prepare test and inspection reports.

END OF SECTION 280513

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SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit, DAC, Knox box.(existing)
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Magnetic door holders.
 - 7. Remote annunciator (existing)
 - 8. Addressable interface device.
 - 9. Firefighters' smoke-control station
 - 10. Digital alarm communicator transmitter (existing).
- B. Related Requirements:
 - 1. Division 23 for duct smoke detectors
 - 2. Division 26 for basic requirements.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

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1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - 6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- C. General Submittal Requirements:
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 - 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician.
 - c. Licensed or certified by authorities having jurisdiction.
- D. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

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3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 include the following:
 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 5. Manufacturer's required maintenance related to system warranty requirements.
 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
- F. Software and Firmware Operational Documentation:
 1. Software operating and upgrade manuals.
 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.8 PROJECT CONDITIONS

- A. Coordinate all device programming and addressing with the Owner.

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1.9 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.10 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. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 5. Keys and Tools: One extra set for access to locked and tamperproofed components.
 - 6. Audible and Visual Notification Appliances: One of each type installed.
 - 7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURER (Existing to be Maintained)

- A. The fire alarm system control panel is a Simplex 4100ES.
- B. All devices utilized for system improvement shall be UL listed to operate with the existing system.
- C. Scope shall include all programming required for any added, replaced or removed device. Provide new system battery and power supply calculations that account for any added, replaced or removed devices. Provide new or additional batteries and power supplies to satisfy system stand-by and activation performance in accordance with NFPA requirements.

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2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors.
 4. Duct smoke detectors.
 5. Verified automatic alarm operation of smoke detectors.
 6. Automatic sprinkler system water flow.
 7. Heat detectors in elevator shaft and pit.
 8. Fire-extinguishing system operation.
 9. Pre-action system operation
 10. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
 2. Identify alarm at fire-alarm control unit and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Release fire and smoke doors held open by magnetic door holders.
 5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 6. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 7. Recall elevators to primary or alternate recall floors.
 8. Activate emergency shutoffs for gas and fuel supplies.
 9. Record events in the system memory
 10. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Low-air-pressure switch of a dry-pipe sprinkler system.
 3. Elevator shunt-trip supervision.
- D. System trouble signal initiation shall 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 primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
 9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

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- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Transmit a trouble or supervisory signal to the remote alarm receiving station.

2.3 FIRE-ALARM CONTROL UNIT (Existing to be Maintained)

- A. General understood performance for the existing Simplex 4100ES Fire-Alarm Control Unit:
 - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder.
 - 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 - 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 40 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
 - 1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
 - a. Notification Appliance Circuits: Style Z.
 - b. Signaling Line Circuits: Style 6.
 - c. Pathway Survivability Level 1.
 - d. Install no more than 50 addressable devices on each signaling line circuit.
 - 2. Serial Interfaces: Two RS-232 ports for printers.

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D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Sound general alarm if the alarm is verified.
4. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

E. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

J. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe

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appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Single-action mechanism, type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 2. Station Reset: Key- or wrench-operated switch.
 3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
 2. Detectors shall be two-wire type.
 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for **15 or 20 deg F** per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at **135 or 155 deg F**.
 - c. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

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2. An operator at fire-alarm control unit, having the designated access level, shall 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.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall 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.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector. Must be UL listed to function with installed fire alarm system.
4. Watertight and Corrosive Resistant Enclosure (for use in each DOAS unit exhaust compartment): NEMA 4X, NRTL listed for use with the supplied detector and equal to performance of Air Products & Controls, model No. RT-3000-P (plus required tube assembly). Must be UL listed to function with installed fire alarm system.
5. Each sensor shall have multiple levels of detection sensitivity.
6. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
7. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

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- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
 - 1. Notification appliance circuit panel (NAC); installed at each floor to provide AC and DC power to support the indication loop devices.
 - 2. Fire alarm terminal cabinets (FATC); installed at each floor to facilitate network, initiation loop and indication loop wiring.
 - 3. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
 - 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, [red] [white].

2.8 REMOTE ANNUNCIATOR (Existing to be Maintained)

- A. Description: Simplex Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

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1. Mounting: Surface cabinet, NEMA 250, Type 1.
2. Refer to plans for proposed location on basement maintenance office

- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.9 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER (Existing to be Maintained)

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
1. Verification that both telephone lines are available.
 2. Programming device.
 3. LED display.
 4. Manual test report function and manual transmission clear indication.
 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
 2. Address of the supervisory signal.
 3. Address of the trouble-initiating device.
 4. Loss of ac supply or loss of power.
 5. Low battery.
 6. Abnormal test signal.
 7. Communication bus failure.

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- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 FIREFIGHTERS' SMOKE-CONTROL SYSTEM

- A. Initiate Smoke-Management Sequence of Operation:
 - 1. Comply with sequence of operation as described in Section 230993 "Sequence of Operations for HVAC Controls."
 - 2. Fire-alarm system shall provide all interfaces and control points required to properly activate smoke-management systems.
 - 3. First fire-alarm system initiating device to go into alarm condition shall activate the smoke-control functions.
 - 4. Subsequent devices going into alarm condition shall have no effect on the smoke-control mode.
- B. Addressable Relay Modules:
 - 1. Provide address-setting means on the module. Store an internal identifying code for control panel use to identify the module type.
 - 2. Allow the control panel to switch the relay contacts on command.
 - 3. Have a minimum of two normally open and two normally closed contacts available for field wiring.
 - 4. Listed for controlling HVAC fan motor controllers

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment and system devices.
- B. Comply with ADA for installation (heights and locations) of occupant manual initiation and indication devices.
- C. Install wall-mounted equipment, with tops of cabinets not more than **72 inches** above the finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- D. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.

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3. Smooth ceiling spacing shall not exceed **30 feet**.
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
 5. HVAC: Locate detectors not closer than **3 feet** from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than **12 inches** from any part of a lighting fixture.
- E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- F. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- G. Remote Status and Alarm Indicators: Install near each smoke detector, heat detector, sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- H. Audible Alarm-Indicating Devices: Install not less than **6 inches** below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn (or a single combined fire alarm system A/V unit) and at least **6 inches** below the ceiling.
- J. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- K. Fire-Alarm Control Unit (and other system cabinets; NAC or FATC): Surface mounted, with tops of cabinets not more than **72 inches** above the finished floor.
- L. Annunciator: Install with top of panel not more than **72 inches** above the finished floor.

3.2 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than **3 feet** from the device controlled. Make an addressable confirmation connection, when such feedback is available, at the device or system being controlled. Refer to other division plans and specifications to coordinate the exact location and quantity for all required addressable control and monitoring modules required to support each related system listed below.
1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 3. Alarm-initiating connection to sprinkler system water flow switches
 4. Smoke dampers in air ducts of designated air-conditioning duct systems.
 5. Alarm-initiating connection to elevator recall system and components.
 6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

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7. Supervisory connections at each sprinkler system valve supervisory switches. Note there are approximately (12) new isolation valves planned for this project. Each will need a new addressable monitor module connected and programmed into the existing system.
8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
9. Supervisory connections at elevator shunt trip breaker.
10. Retain one of three subparagraphs below.
11. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
12. Supervisory connections at fire-pump engine control panel.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by Owner's representative.
- B. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

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2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the 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.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

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SECTION 283115 - EMERGENCY RESPONDER RADIO ANTENNA/REPEATER SYSTEM

Signal Strength Testing – BASE BID

Furnish and Install System – ADD ALTERNATE

PART 1 - GENERAL

1.1 SUMMARY

- A. Under the BASE BID contract provide fire fighter communication system signal strength testing for the facility. Testing shall occur once final finishes have been applied and FFE has been installed. Results of signal strength testing will be shared and reviewed by the fire department for final agreement as to whether the repeater system is required or is not. Should it be determined as a result of the signal strength testing that the antenna/repeater system is required then provide an ADD ALTERNATE price to the owner for system procurement and installation within the base bid project completion schedule.
- B. Furnish, install, and test a complete and operating Emergency Responder Radio Antenna/Repeater System. The system will support only the Fire Department radio system and no others. Provisions for supporting other public safety systems (e.g. police); cellphone carriers; the Owners' private security and/or maintenance personnel radio systems, etc. – now or in the future – shall not be included.
- C. This Section includes the requirements for an Emergency Responder Radio Antenna/Repeater System for the purposes of amplifying Emergency Responder radio signals to achieve minimum signal strength in 95% of all areas on each floor of the building.
- D. Final acceptance and approval is required from the local Fire Department in writing prior to contract closeout.
- E. Section Includes
 - 1. Bi-directional amplifiers (BDA's)
 - 2. Distributed Antenna System
 - 3. Coaxial cables
 - 4. Splitters and direction couplers
 - 5. UPS
 - 6. All other equipment and components necessary for a complete and functioning Emergency Responder Radio Antenna/Repeater System.

1.2 REGULATIONS

- A. Codes, regulations and standards referenced in the Section are:
 - 1. NFPA 1 – The National Fire Code (including Annex O from 2009)

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2. NFPA 70 – The National Electrical Code
3. NFPA 101, Life Safety Code, the Ohio Basic Building Code, and Local Code and Building Authority requirements.
4. NFPA 72 National Fire Alarm and Signaling Code
5. FCC 47 CFR Private Land Mobile Radio
6. 90.219-2007 Services-Use of Signal Boosters
7. ICC 2009 International Fire Code, Code and Commentary
8. ADA "Americans with Disabilities Act"
9. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields".
10. FCC Rules Part 22, Part 90 and Part 101.

1.3 DEFINITIONS

- A. Bi-Directional Amplifier BDA: Device used to amplify band-selective or multi-band RF signals in the uplink, to the base station for enhanced signals and improved coverage.
- B. Emergency Responder Radio Coverage System: A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.
- C. Delivered Audio Quality Definitions (DAQ): This is a universal standard often cited in system designs and specifications.
 1. DAQ 1: Unusable, speech present but unreadable.
 2. DAQ 2: Understandable with considerable effort. Frequent repetition due to noise/distortion.
 3. DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise/distortion.
 4. DAQ 3.5: Speech understandable with repetition only rarely required. Some noise/distortion
 5. DAQ 4: Speech easily understood. Occasional noise/distortion.
 6. DAQ 4.5: Speech easily understood. Infrequent noise/distortion.
 7. DAQ 5: Speech easily understood. Coupled Bonding Conductor (CBC) – The term "Coupled Bonding Conductor" shall mean a bonding conductor placed, e.g. strapped, on the outside of any technology cable, used to suppress transient noise.
- D. FCC: Federal Communications Commission
- E. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- F. Public Safety/First Responder: Public Safety or First Responder agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to: law enforcement departments, fire departments, and emergency medical companies.

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1.4 SUBMITTALS

- A. Submit product data for each type of proposed system component specified, including dimensioned drawings showing minimum clearances and installed features.
- B. Layout Drawings
 - 1. Component specification sheets shall be 8.5 inch x 11 inch or greater, scaled or dimensioned, with dimensions or scale clearly noted.
 - 2. Floor plan drawings shall be 24 inch x 36 inch minimum with drawings scaled to legible size.
 - 3. Floor plan drawings may include elevation detail names for each elevation view. Sheet title shall include site name, address, sheet number, floor plan number and north arrow. Include site plan view of the subject buildings and surrounding property to clearly indicate the location and orientation of roof mounted outdoor antennas associated with the proposed system.
 - 4. Include a minimum of (1) building elevation depicting the location of any outdoor antennas associated with the proposed system. Include height of antenna centerline above building, orientation, and location of all external grounding connections.
 - 5. Include a detail plan view of all Telecommunications Spaces housing head-end and/or other consolidated equipment, showing the location of the rack(s) and/or enclosure(s) of the Emergency Responder Radio Antenna/Repeater System equipment.
 - 6. Include a separate plan view of each interior floor where indoor antenna systems are proposed. Include antenna numbers, coaxial cable routes, and the locations of any other system components including splitters, couplers, filters, amplifiers, etc. All components shall be named or labeled for reference in power budget calculations tables. Overlay approximated coverage radii indicating -95 dBm downlink (base to mobile) signal strength around each proposed indoor coverage antenna. Include results of any previous coverage testing per grid, if available.
 - 7. Include a minimum of one (1) detail elevation view(s) of all rack(s) and/or enclosure(s) housing the Emergency Responder Radio Antenna/Repeater System equipment.
 - 8. Identify each piece of equipment by brand, model number and equipment type (e.g. Acme BA123 RF amplifier).
 - 9. Specify antenna grounding and surge protection in accordance with NEC Article 810.
 - 10. Specify the backup power source (Life Safety), and include calculations to ensure the backup power requirements as specified in this standard are met.
- C. Equipment Specification Sheets
 - 1. Provide copies of manufacturer specification sheets of all system components, including:
 - a. Amplifiers
 - b. Antennas
 - c. Coaxial cable, couplers, splitters, combiners, or other passive components
 - 2. Operation and maintenance data

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3. Pass band curves in for the uplink and downlink portions of the NPSPAC band for any amplifiers, if not included in #1. Amplifiers may NOT amplify portions of other licensed services, including Nextel and Specialized Mobile Radio Licensee band, or Cellular A or B bands.
 4. Backup battery and charging system.
- D. Submit wiring diagrams from manufacturer differentiating clearly between factory and field-installed wiring. Include diagrams for each component of the system with all terminals and interconnections identified. Make all diagrams specific to this Project.
- E. Submit product certificates signed by the manufacturer of radio system components certifying that their products comply with specified requirements.
- F. Submit agenda for training class and copies of all handouts for the class.
- G. Maintenance data for radio system shall be included in the operation and maintenance manual. Include data for each type of product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.
- H. Record of field tests of the radio system shall be included in the operation and maintenance manuals.
- I. Design Approval: Plans shall be submitted and approved prior to installation. The following information shall be provided to the local Fire Department unit representative by the system designer/Contractor:
1. A minimum of three (3) copies of detailed drawings showing the location of the amplification equipment and associated antenna systems which includes a view showing building access to the equipment; and
 2. A minimum of three (3) copies of schematic drawings of the electrical system, backup power, antenna system and any other associated equipment relative to the amplification equipment including panel locations and labeling.
 3. A minimum of one (1) copy of the Manufacturer's data sheets on all equipment to be installed.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced factory-authorized installer to perform work of this Section.
- B. Single-Source Responsibility: Obtain radio system components from a single source who assumes responsibility for compatibility of system components.
- C. All equipment shall be UL listed and labeled, and in accordance with applicable NEMA and ANSI Standards. Where copper cabling is routed to an area, either in another building, or with a separate electrical service, the Technology Contractor shall provide primary protective equipment.

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- D. All racks and enclosures shall be either welded or assembled with paint piercing ground washers, grounding strip and bonding jumper as indicated on the Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Subject to compliance with requirements, available Integrators offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Radio Solutions, Inc
 2. Corning
 3. Times Microwave
 4. Tessco
 5. CCI (Communication Components Inc.)
 6. Solid Technologies
 7. CommScope/Andrew

2.2 GENERAL PERFORMANCE REQUIREMENTS

- A. Compatibility: The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna system, etc., shall not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies.
- B. Power Supplies: At least two (2) independent and reliable power supplies shall be provided, one primary and one secondary. The primary power source shall be supplied from a dedicated 20 ampere branch circuit and comply with 4.4.1.4 of NFPA 72. The secondary power source shall be a dedicated battery, capable of operating the in-building radio system for at least 12 hours of 100% system operation. The battery system shall automatically charge in the presence of external power input. The battery system shall be contained in one NEMA 4 or 4X type enclosures. Monitoring the integrity of power supplies shall be in accordance with 4.4.7.3 of NFPA 72.
- C. Survivability
1. Physical Protection: All wiring and fiber optics shall be installed in conduit. Refer to Section 260533, "Conduit and Fittings" for type, sizing and installation standards.
 2. Fire Performance: All main risers or trunks of the antenna system shall be installed with resistance to attack from a fire using one of the following methods:
 - a. A 2-hour fire rated cable or cable system.
 - b. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
 - c. A system configured in a looped design, routed through 1-hour fire rated enclosure(s) or shaft(s). The circuit shall be capable of transmitting and receiving a signal during a single open or non-simultaneous single ground fault on a circuit conductor.

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- d. Performance alternative approved by the authority having jurisdiction.
- 3. Cabinet: The signal booster and all associated RF filters shall be housed in a single, NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. Operating temperatures: -22 degrees F to +120 degrees F (-30 degrees C to +50 degrees C) minimum temperature range, including microprocessors. Equipment installed on the roof of structures shall be rated for the expected extreme temperatures associated with rooftop installations.
- 4. Passive Equipment: Passband shall be 700-900 MHz, IP rating of 2 GHz.
- 5. Cable: Passband shall be 700-900 MHz. Cable shall be rated for fire plenum and riser rating.

2.3 SYSTEM COMPONENTS

A. Signal Strength

- 1. Downlink: A minimum signal strength of -95 dBm shall be provided throughout the coverage area.
- 2. Uplink: Minimum signal strength of -95 dBm received at the local Fire Department Radio System from the coverage area.
- 3. A donor antenna must maintain isolation from the distributed antenna system. The donor antenna signal level shall be a minimum of 15 dB above the distributed antenna system under all operating conditions.

B. Permissible Systems

- 1. Buildings and structures shall be equipped with an FCC Certificated Class B Bi-Directional UHF Amplifier(s) as needed.
- 2. The distributed antenna system may utilize a radiating cable, fixed antennas or a combination of both.

C. Supported Frequencies: The radio system shall support frequencies in the 700 and 800 MHz public safety bands as utilized by the local Fire Department.

D. Reject Filters: Notch filter sections shall be incorporated to minimize adjacent channel cellular and SMR (Nextel) degradation of the signal booster performance. The minimum downlink band adjacent band rejection shall be 35 dB or greater at 865 MHz and 870 MHz.

E. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes within the NPSPAC band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.

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- F. Output Level Control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.
- G. Degraded Performance in Emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) will not be implemented as the standard mode for public safety applications.
- H. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.
- I. All in-building radio systems shall be compatible with both analog and digital communications simultaneously at the time of installation.

2.4 SYSTEM MONITORING

- A. The distributed antenna system shall include a connection to the fire alarm system to monitor the integrity of the circuit of the signal booster(s) and power supplies and annunciate this malfunction on the fire alarm system shall comply with 4.4.7.1 of NFPA 72.
- B. A sign shall be located at the fire alarm panel with the name and telephone number of the local Fire Department indicating that they shall be notified of any failures that extend past the 2 hour time limit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Distribution System Signal Wires and Cables.
 - 1. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
 - 2. Routing and Interconnection
 - a. Wires or cables routed between consoles, cabinets, racks, and other equipment shall be installed in an approved conduit or cable tray that is secured to building structure.
 - b. Completely test all of the cables after installation and replace any that are found to be defective.
 - 3. Install cables without damaging conductors, shield, or jacket.

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4. Do not bend cables, while handling or installing, to radii smaller than as recommended by manufacturer.
5. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

B. Product Delivery, Storage, and Handling

1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment model and serial identification numbers.
2. Store and protect equipment in a conditioned space until installation.

C. System Installation

1. Coaxial antenna cabling shall not be installed in the same conduit, raceway, or cable trays used for other systems.
2. All equipment shall be connected according to the OEM's specifications to insure correct installation and system performance.
3. Coordinate all roof penetrations with Owner and/or roofing contractor.

3.2 LICENSING

- A. All fees associated with the licensing shall be paid by the Owner.
- B. All testing must be done on frequencies authorized by the FCC.

3.3 GROUNDING

- A. Ground cable shields and equipment per Manufacturer's requirements.
- B. Antenna mast shall be grounded per NFPA 70 NEC requirements, Section 270526, "Grounding and Bonding for Communications Systems" and antenna manufacturer's requirements. Provide grounding blocks and surge protection for outside coaxial cabling. Bond the antenna mast to the existing lightning protection system.

3.4 APPROVAL TESTING

- A. The local Fire Department will review plans and specifications. Upon acceptance, plans will be stamped to indicate approval. Stamped plans are required to be present at the acceptance test. Any field changes that occur during construction shall be incorporated into new As-Built plans, including any manufacturer's data sheets for any equipment changes not submitted in the original submittal. As-Built plans, if required due to system changes, shall be submitted to the local Fire Department for approval.
- B. Tests shall be made using frequencies close to the frequencies used by the Fire Department and appropriate emergency services. If testing is done on the actual frequencies, then this testing must be coordinated with the local Fire Department unit. All testing must be done on

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frequencies authorized by the FCC. A valid FCC license will be required if testing is done on frequencies different from the police, fire or emergency medical frequencies.

C. Testing Procedures

1. Minimum Signal Strength: For testing system signal strength and quality, the testing shall be based on the delivered audio quality (DAQ) system. A DAQ level below 3.0 shall be considered a failed test for a given grid cell.
2. Measurements shall be made with the antenna held in a vertical position at 3 to 4 feet above the floor to simulate a typical portable radio worn on the belt or turnout coat pocket.

D. Final Acceptance Testing

1. All acceptance testing shall be done in the presence of a local Fire Department representative or by the local Fire Department unit at no expense to the City.
2. Small scale drawings (11 inch x 17 inch maximum) of the structure shall be provided by the Contractor to the Owner. The plans shall show each floor divided into the grids as described above, and the results of the pre-testing. Each grid shall be labeled to indicate the DAQ result from the final acceptance testing.
3. The Contractor shall provide the latest approved plans for the system, including any manufacture's data sheets for any equipment changes not submitted in the original submittal to the Owner.
4. Include testing results of the repeater (output wattage, gain level, etc) and connection to the fire alarm.

3.5 MAINTENANCE AND ANNUAL TESTING

A. Annual tests will be conducted by the local Fire Department unit or authorized company.

1. The re-testing will be done at no expense to the City or the appropriate emergency services departments as required in the original testing procedures.

B. Maintenance Contract

1. Maintenance contract with a Radio Service Provider in place with name of authorized company, who will provide a 24 hour by 7 day emergency response within two (2) hours after notification. The system shall be maintained in accordance with FCC requirements. The contract shall be for 5 years.
2. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio telephone Operator License, or a technician certification issued by the Association of Public-Safety Communications Officials International (APCO) or equivalent as determined by the local Fire Department.
3. Maintain a list of contact personnel with phone numbers at the radio repeater system cabinet. The contact personnel shall have knowledge of the building and the repeater system and be available to respond to the building in the case of an emergency.
4. Radio Service Provider maintenance contract shall include but not limited to:

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- a. Annual Test
 - 1) All active components of the distributed antenna system, including but not limited to amplifier, power supplies, and back-up batteries, shall be tested a minimum of once every 12 months.
 - 2) Amplifiers shall be tested to insure that the gain is the same as it was upon initial installation and acceptance. The original gain shall be noted and any change in gain shall be documented.
 - 3) Back-up batteries and power supplies shall be tested under load for a period of 1 hour to verify that they will operate during an actual power outage.
 - 4) Active components shall be checked to determine that they are operating within the manufacturer's specifications for their intended purpose.
 - 5) Documentation of the test shall be maintained on site and a copy forwarded to the local Fire Department Radio Supervisor upon completion of the test.
- 5. Fire Department Radio personnel, after providing reasonable notice to the Owner or their representative, shall have the right to enter onto the property to conduct field testing to be certain that the required level of radio coverage is present.

END OF SECTION 283115