

SPECIFICATIONS FOR
BOILER REPLACEMENT & RELATED WORK

AT

SEVERAL SCHOOLS

HOLLYWOOD ELEMENTARY SCHOOL

1135 RIVERVIEW AVENUE, MONROE, MI 48162

FILE #26101

ORCHARD CENTER HIGH SCHOOL

1750 OAK STREET, MONROE, MI. 48161

FILE #26102

FOR

MONROE PUBLIC SCHOOLS

1275 NORTH MACOMB STREET, MONROE, MI. 48162

FEBRUARY 9, 2026



KOHLER
ARCHITECTURE

www.kohlerarchitect.net

1110 WEST FRONT STREET

MONROE, MI. 48161

PH:(724)242-6880

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Boiler Replacement & Related Work
at Several Schools

#26101-#26102

Monroe Public Schools

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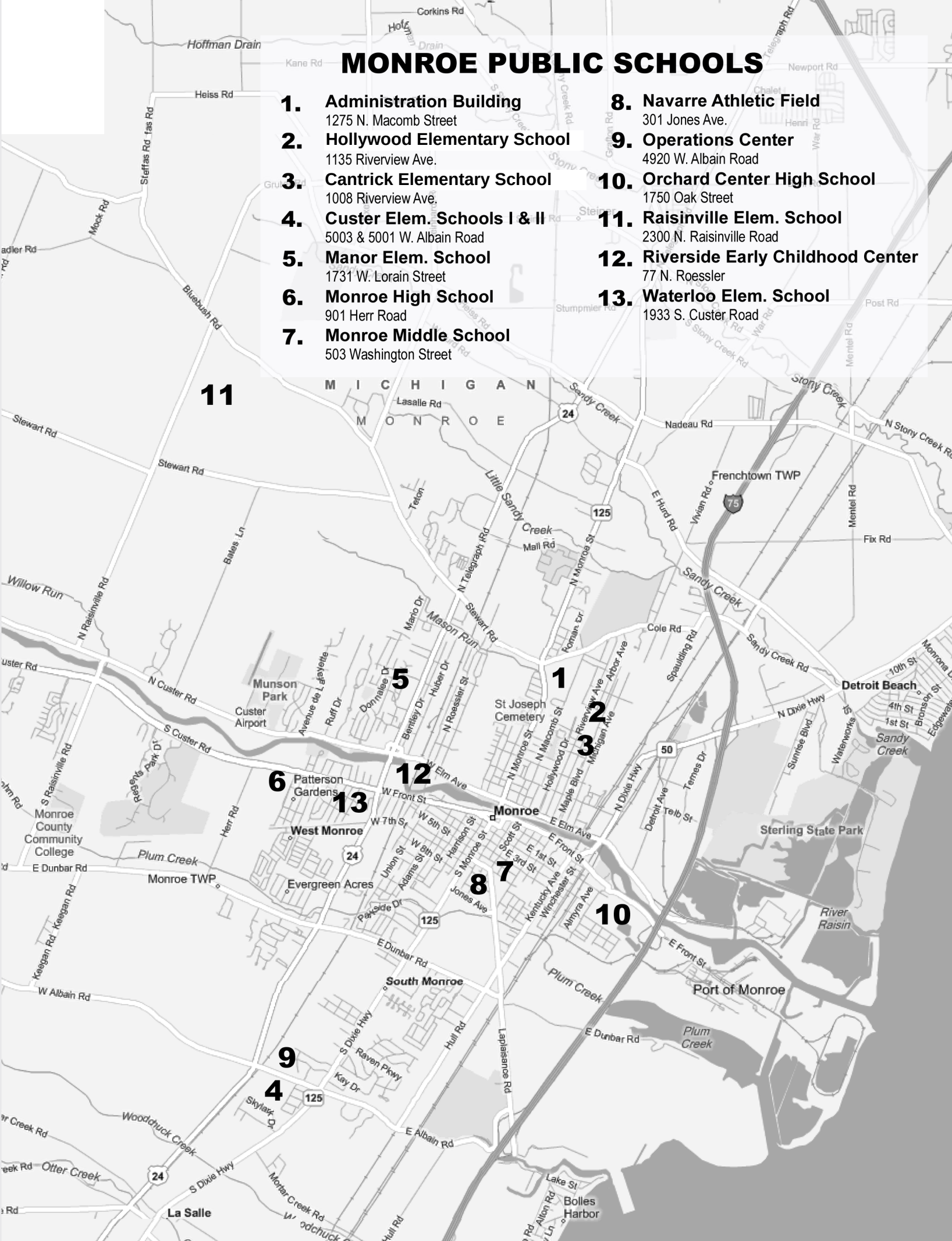
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MONROE PUBLIC SCHOOLS

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1731 W. Lorain Street
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901 Herr Road
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301 Jones Ave.
- 9. Operations Center**
4920 W. Albain Road
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1750 Oak Street
- 11. Raisinville Elem. School**
2300 N. Raisinville Road
- 12. Riverside Early Childhood Center**
77 N. Roessler
- 13. Waterloo Elem. School**
1933 S. Custer Road



ADVERTISEMENT FOR BIDS

OWNER:

Monroe Public Schools
1275 North Macomb St
Monroe, MI. 48162
Phone: (734) 265-3000

ARCHITECT:



KOHLER ARCHITECTURE

1110 West Front St.
Monroe, MI. 48161
Phone: (734) 242-6880

PROPOSALS: Separate sealed proposals for Prime Contractors are invited for the following construction work: **Boiler Replacement and Related Work at Several Schools (#26101) Hollywood Elementary School, 1135 Riverview Avenue, Monroe, MI. 48162, and at (#26102) Orchard Center High School, 1750 Oak Street, Monroe, MI. 48161, for Monroe Public Schools, 1275 North Macomb Street, Monroe, MI. 48162.** Proposals are for all projects and complete, including all trades (Sub-Contractors and Suppliers), as the successful Contractor will be considered a Prime Contractor entering into a direct contract with the Owner.

DUE DATE: Proposals will be received by the owner until **Wednesday, March 11, 2026 at 3:00 P.M.**, at the Monroe Public Schools Administration Building, 1275 North Macomb Street, Monroe, MI 48162. Bids will be publicly opened and read aloud at that time at the same location. The School Board will not consider or accept any bid submitted after the due date and time.

PLANS: Electronic pdf copies will be available for viewing and/or downloading at no cost from the Monroe Public Schools website at <https://bids.monroe.k12.mi.us>. Hard copies of plans and specifications may be purchased for \$150.00 for each set from the office of Kohler Architecture, Inc. located at 1110 West Front Street, Monroe, MI., 48161.

The project will be advertised on the Buy4Michigan.com website and at Builders Exchange of Michigan, Grand Rapids, MI; CMD (Construction Market Data), Norcross, GA; Construction Association of Michigan, Bloomfield Hills, MI.; Dodge Data & Analytics, Cincinnati, OH. Only bidders registered with the Architect will be sent any addendums and receive any other information regarding this project.

MANDATORY PRE-BID MEETING: A mandatory pre-bid meeting will be held at the job sites **Wednesday February 25, 2026. Orchard Center High School – 3:30 p.m., Hollywood Elementary School – 4:15 p.m.**

These meetings are for the Prime Contractors, (NOT Sub-Contractors), to gain knowledge about the project and submit proof of qualifications for pre-approval. The Architect's Project Manager, will be at this meeting to clarify the bidding procedures, scope of work, identify any items of concern and answer questions from the Bidders for their preparation and submission of representative competitive bids. It is the Contractor's responsibility to assure the Architect has been furnished all necessary information as listed in Instructions to bidders at or prior to this meeting. The Architect will assemble an official list of approved bidders two days after the mandatory pre-bid meeting. The list will be limited to Contractors who attend the entire pre-bid meeting, have signed an official attendance list, have checked out official plans and specifications from the Architect, and meet the minimum Contractor qualifications as listed in the Instructions to Bidders. **Bids submitted by Contractors who are not on the approved bidders list or do not meet these pre-bid requirements will not be opened and will be returned to the bidder.**

PROPOSAL GUARANTEE: The proposal must be accompanied by a certified check or bid bond by an approved surety company in the amount of five percent (5%) of the proposal submitted payable to the Owner. Proposals shall remain firm for a period of sixty (60) days after official opening of bids.

CONTRACT SECURITY: The successful Contractor will be required to furnish performance, labor and material bonds, each in the full amount of the proposal if payments are issued prior to completion and/or the contract is \$50,000.00 or more.

FAMILIAL DISCLOSURE: All bidders must provide disclosure in compliance with MCL 380.1267 and attach this information to the bid. The bid shall be accompanied by a sworn and notarized statement disclosing any familial relationship that exists between the Owner or the employee of the bidder and any member of the board, intermediate school board, or board of directors or the superintendent of the school district, intermediate superintendent of the intermediate school district, or chief executive officer of the public school academy. The District shall not accept a bid that does not include this sworn and notarized disclosure statement.

IRAN ECONOMIC SANCTIONS ACT COMPLIANCE: All bidders must provide a sworn and notarized statement in compliance with Iran Economic Sanctions Act, Michigan Public Act No. 517 of 2012 and attach this information to the bid. The District shall not accept a bid that does not include this sworn and notarized statement.

RIGHT RESERVED BY OWNER: The Owner reserves the right to waive any irregularities, reject any or all bids, or accept the bid that in the opinion of the Owner, will serve the best interests of the Owner.

PROPOSAL FORM
(Submit in Duplicate)

To: Secretary of the School Board:

Having carefully examined the Instructions to Bidders, the Specifications and Drawings, including Addendum No. _____, all entitled, "Boiler Replacement and Related Work at Several Schools (#26101) Hollywood Elementary School, 1135 Riverview Avenue, Monroe, MI. 48162, (#26102) Orchard Center High School, 1750 Oak Street, Monroe, MI. 48161, for Monroe Public Schools, 1275 North Macomb Street, Monroe, MI. 48162", as well as the premises and the conditions affecting the work, the undersigned agrees to furnish all labor and materials to perform the work, including All Trades, and agrees to accept in payment therefore, the sum of:

PROPOSAL A (Base Bid)

_____ Dollars
(\$_____)

ALTERNATE #1 (ADD) - Installation of Gas Fired Domestic Water Heaters at Both Hollywood Elementary School and Orchard Center High School

_____ Dollars
(\$_____)

BOILER MANUFACTURER – List Manufacturer of Boiler that will be provided as part of the Base Bid for Both Schools.

The following form of bid guarantee, as indicated below, is herewith enclosed, representing 5% of the amount of the Total Bid, including Alternates, payable to the Owner:

Certified Check _____ Bid Bond _____

It is agreed that this bid may not be withdrawn for a period of 60 days. The Owner reserves the right to waive any irregularities, reject any or all bids or accept the bid that in the opinion of the Owner will serve the best interest of the Owner.

Guaranteed Maximum percentage of mark-up values on change orders including Overhead, profit, bond, insurance, wage rates, and equipment rates for BOTH prime contractors and subcontractors will not more than _____%.

The undersigned agrees, if awarded the contract, to commence construction immediately and to complete work as noted in Division #1. (Notes: See Supplemental and Special conditions for Liquidated Damages and Instructions to Bidders for Architect's Inspections and Additional Services.)

PROPOSAL FORM
(Submit in Duplicate)

SUB-CONTRACTORS - The undersigned submits for your approval herewith as a condition of being awarded the contract, the **separately attached list** of Contractors to whom it is proposed to let portions of this work, agreeing in every way to be responsible for the work, materials, equipment and supplies furnished by each and all of them. **A tentative list shall be submitted with bid and confirmed/verified no later than 24 hours after bid opening.**

SUBSTITUTIONS - The following is a list of manufacturers or trade names of substitute materials and equipment, which the undersigned submit for consideration, guaranteeing the same to conform to exact requirements of the specifications. The additions, deductions or no-charge figures indicated are separate from and not part of the proposal. **A tentative list shall be submitted with bid and confirmed/verified no later than 24 hours after bid opening.**

Item	Substitute Mfr./Trade Name	Add	Deduct	No Charge
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

FAMILIAL DISCLOSURE – As required by the State of Michigan, and included as part of this proposal, shall be an Affidavit for Statement Regarding Familial Relationship, completely filled out and signed.

IRAN ECONOMIC SANCTIONS ACT COMPLIANCE - As required by the State of Michigan, and included as part of this proposal, shall be an Affidavit of Compliance of the Iran Economic Sanctions Act, Michigan Public Act No. 515 of 2012, completely filled out and signed.

BIDDER'S COMPLIANCE ASSURANCE- Sign in the space provided below to confirm that you have read, understand, and will comply with the requirements as stated in this project manual, including, but not limited to the sections dealing with the following: (1) criminal/security checks/records and, (2) Qualification of Bidders.

(PLEASE PRINT OR TYPE)

Date _____	Firm _____
Address _____	By _____
_____	Signature _____
Phone _____	Title _____
Email _____	Fed. Tax ID _____

STATEMENT REGARDING FAMILIAL RELATIONSHIP

AFFIDAVIT OF _____

(insert name of affiant)

STATE OF _____) SS:

COUNTY OF _____)

_____ makes this Affidavit under oath and states as follows:

(insert name of affiant)

1. I am a/the: ☐ President
☐ Vice-President
☐ Chief Executive Officer
☐ Member
☐ Partner
☐ Owner
☐ Other (please specify) _____

of _____, a bidder on a construction project for
(insert name of contractor)

Monroe Public Schools that involves, at least in part, construction of a new school building or an addition to or repair or renovation of an existing school building or other facilities.

2. I have personal knowledge and/or I have personally verified that the following are all of the familial relationships existing between the owner(s) and the employee(s) of the aforementioned contractor and the school district's superintendent and/or board members:
(leave blank if none)

3. I have authority to bind the aforementioned contractor with the representations contained herein, and I am fully aware that the school district will rely on my representations in evaluating bids for the construction project.
4. I declare the above information to be true to the best of my knowledge, information and belief. I could completely and accurately testify regarding the information contained in this affidavit if requested to do so.

(signature of affiant)

Dated: _____

Subscribed and sworn before me in _____ County,

_____, on the ____ day of _____, 20____.
(state)

_____ (signature)

_____ (printed)

Notary public, State of _____, County of _____

My Commission expires on _____

Acting in the County of _____

**AFFIDAVIT OF COMPLIANCE
IRAN ECONOMIC SANCTIONS ACT**

Michigan Public Act No. 517 of 2012

AFFIDAVIT OF _____
(insert name of affiant)

STATE OF _____) SS:

COUNTY OF _____)

_____ makes this Affidavit under oath and states as follows:
(insert name of affiant)

1. I am a/the: ☐ President
☐ Vice-President
☐ Chief Executive Officer
☐ Member
☐ Partner
☐ Owner
☐ Other (please specify) _____

of _____, a bidder on a construction project for
(insert name of contractor)

Monroe Public Schools that involves, at least in part, construction of a new school building or an addition to or repair or renovation of an existing school building or other facilities.

2. I personally certify, represent and warrant that the Bidder (including its officers, directors and employees) is not an "Iran Linked Business" within the meaning of the Iran Economic Sanctions Act, Michigan Public Act No. 517 of 2012 (the "Act"), and that in the event the Bidder is awarded a Contract as a result of the aforementioned Advertisement for Bids, the Bidder will not become an "Iran Linked Business" at any time during the course of performing under the Contract.

The Bidder further acknowledges that any person as that term is defined in Section 2(f) of the "Act" who is found to have submitted false certification is responsible for a civil penalty of not more than \$250,000.00 or 2 times the amount of the Contract or proposed Contract for which the false certification was made, whichever is greater plus the cost of the Owner's investigation, and reasonable Attorney fees in addition to the fine. Moreover, any person who submitted a false certification shall be ineligible to bid on an Invitation to Bid or submit a proposal as to any Request for Proposals for a period of three (3) years from the date that it is determined that the person has submitted the false certification.

3. I have authority to bind the aforementioned contractor with the representations contained herein, and I am fully aware that the school district will rely on my representations in evaluating bids for the construction project.
4. I declare the above information to be true to the best of my knowledge, information and belief. I could completely and accurately testify regarding the information contained in this affidavit if requested to do so.

(signature of affiant)

Dated: _____

Subscribed and sworn before me in _____ County,
_____, on the ____ day of _____, 20____.
(insert state)

(signature)

(printed)

Notary public, State of _____, County of _____

My Commission expires on _____

Acting in the County of _____

Project Schedule

This reflects an anticipated project schedule for this construction project. Contractors shall familiarize themselves with this schedule and note any conflicts on the proposal form. The project schedule will be reviewed, coordinated, and finalized at the contractor/owner pre-construction meeting.

<u>Description</u>	<u>Date</u>
Out for Bids	February 9, 2026
Mandatory Pre-bid Meeting	February 25, 2026 at 3:30 pm Orchard Center High School at 3:30 pm Hollywood Elementary school at 4:15 pm
Official Bidders List	February 26, 2026
Bids Due	March 11, 2026 at 3:00 pm
Post Bid Interviews	March 12-17, 2026
Architect Recommendation	March 18, 2026
Owner Awards Project	March 24, 2026
Notice to Proceed Letters	March 25, 2026
All Shop Drawing Reviews Complete	May 22, 2026
Pre-Construction Meeting	May 22, 2026 – Time and place TBD
Physical Construction	June 15, 2026 – August 14, 2026
Substantial Completion	August 14, 2026
Owner Move-in Date	August 19, 2026
Final Completion	September 14, 2026



Kohler Architecture, Inc.
1110 West Front Street
Monroe, MI. 48161
(734)242-6880

Files: \26101-26102-26106 Project Schedule

**SECTION 002113
INSTRUCTIONS TO BIDDERS**

INVITATION

1.01 PROPOSAL SUBMISSION

- A. Bids signed and sealed, executed, and dated will be received per the Advertisement for Bids.
- B. Submit required Supplements To Bid Forms within 24 hours after closing time for receiving bids.
- C. Amendments to the submitted offer will be permitted if received in writing prior to bid closing and if endorsed by the same party or parties who signed and sealed the offer.

1.02 INTENT

- A. All work specified in this project manual shall be bid as one package. The prime contractor (assumed Mechanical Contractor) shall be responsible to assemble and collect all parts, materials, equipment, labor, etc. as required for a complete finished installation at completion. Included shall be architectural (patching, demolition, finishes, roofing, etc.) mechanical, electrical, plumbing, and all other related trades as required for a complete project.

1.03 CONTRACT TIME

- A. The bidder, in submitting an offer, will perform the Work within the time stated in Section 001300 - Project Schedule.

BID DOCUMENTS AND CONTRACT DOCUMENTS

2.01 CONTRACT DOCUMENTS IDENTIFICATION

- A. All work shall be performed under this contract as described in this project manual as prepared by Kohler Architecture, Inc. Included, but not limited to are; Title Sheet, Index, Advertisement for Bids, Bid Proposal Form, Instructions to Bidders, Certificate of Insurance, Specifications - All Divisions, Drawings, etc.

2.02 AVAILABILITY

- A. Electronic pdf copies will be available for viewing and/or downloading at no cost from the Monroe Public Schools website at <https://bids.monroe.k12.mi.us>. Hard copies of plans and specifications may be purchased for \$150.00 for each set from the office of Kohler Architecture, Inc. located at 1118 West Front Street, Monroe, MI., 48161. These are the official and only recognized places that addenda and other information regarding this project will be posted.
- B. The project will be advertised on the Bid4Michigan.com website and at Builders Exchange of Michigan, Lansing, MI; Construct Connect (formerly CMD), Norcross, GA; Construction Association of Michigan, Bloomfield Hills, Mi.; Dodge Data & Analytics. Cincinnati, OH.
- C. Bid Documents are made available only for the purpose of obtaining offers for this project. Their use does not grant a license for other purposes.

2.03 EXAMINATION

- A. Bid Documents may be viewed at the office of Architect.
- B. Upon receipt of Bid Documents verify that documents are complete. Notify Architect should the documents be incomplete.
- C. Immediately notify Architect upon finding discrepancies or omissions in the Bid Documents.
- D. Each bidder shall examine all drawings, specifications and all other data or instructions pertaining to the work. No plea of ignorance of conditions that exist or of difficulties of conditions that may be encountered, or of any other relevant matter concerning that work to be performed in the execution of the work will be accepted as an excuse for any failure or omission on the part of the Contractor to fulfill every detail of all the requirements of the contract documents, governing the work. The bidder, if awarded the contract, will not be allowed extra compensation by reason of any matter or thing concerning which such bidder might have fully informed himself prior to bidding.

2.04 INQUIRIES/ADDENDA

- A. Addenda may be issued during the bidding period. All Addenda become part of Contract Documents. Include resultant costs in the Bid Amount.
- B. If any person contemplating submitting a bid is in doubt as to the true meaning of any part of the plans or specifications, or other proposed contract documents, or requesting a change, they shall submit to the Architect a written request for interpretation which shall be delivered to the Architect at least (7) days before the opening of bids. Any interpretation of the proposed documents will be made only by an addendum duly issued.
- C. Such addendum will be posted in the same manner as original bid documents. If after the pre-bid meeting and approved bidders are known, notice of such addendum may be emailed to each approved bidder. It shall be the bidder's responsibility to make inquiry as to addenda issued. Any addendum issued during the time of bidding shall be included in the bid, and in closing a contract will become a part thereof.
- D. Any verbal information obtained from or statements made by representatives of the Owner or Architect at the time of examination of the contract documents or site shall not be construed as in anyway amending the contract documents. Only such corrections or addenda as are issued in writing to all bidders shall become a part of the contract. Neither the Owner nor the Architect will be responsible for verbal instructions. Verbal answers are not binding on any party.

2.05 VOLUNTARY SUBSTITUTIONS

- A. For a bid proposal to be accepted by the Owner, and considered for contract award, it must contain costs to perform the work exactly as specified. The bidder is required to perform all work, all materials, etc., as specified. Voluntary substitutions may be listed in the bid proposal by the bidder but will only be considered if the Contractor first bids on the work as specified. The bidder must be considered the lowest bonafide, qualified, bidder in the base specified bid before the voluntary substitution is considered.
- B. If a bidder feels a product, assembly of products, or an equal solution is available to perform the same design intent, he shall contact the Architect for review and if approved, will be issued in an addendum as described elsewhere, as an "approved equal".

SITE ASSESSMENT

3.01 SITE EXAMINATION

- A. The bidder shall carefully examine the site of each project and surrounding territory, the means of approach to the site and the structure of the ground and make all necessary investigations required to inform himself thoroughly and fully as to facilities for delivery, storing, placing and handling of materials and equipment and to inform himself fully as to all difficulties that may be encountered in the complete execution of all work in accordance with the contract documents.
- B. For making appointment to visit the site and enter the building, bidders should contact:
Mr. Tim Salenbien, Custodial/Maintenance Supervisor, Monroe Public Schools, 4920 West Albain Road, Monroe, MI 48161 (Phone 734-265-3333)

3.02 MANDATORY PRE-BID MEETING

- A. A mandatory pre-bid meeting will be held at the time and place noted in the Advertisement for Bids. This meeting is for the Prime Contractors, (NOT Sub-Contractors), to gain knowledge about the project and submit proof of qualifications. The Architect's Project Manager, will be at this meeting to collect proof of qualification documentation, clarify the bidding procedures, scope of work, identify any items of concern and answer questions from the Bidders for their preparation and submission of representative competitive bids. It is the Contractor's responsibility to assure the Architect has been furnished all necessary documentation as listed below at or prior to this meeting. The Architect will assemble a list of bidders within seven days after the mandatory pre-bid meeting. The list will be limited to Contractors who attend the entire pre-bid meeting, have signed an official attendance list, and meet the minimum Contractor qualifications as listed in the Instructions to Bidders, and the Advertisement for

Bids. **Bids submitted by Contractors who are not on the approved bidders list or do not meet these pre-bid requirements will not be opened and will be returned to the bidder.**

- B. See Contractor Requirements Section for list of Qualifications to be delivered to the Architect, **at or before**, the Mandatory Pre-Bid Meeting:

CONTRACTOR REQUIREMENTS

4.01 EVIDENCE OF QUALIFICATIONS

- A. The following is a list of items to be delivered to the Architect, at or before, the Mandatory Pre-Bid Meeting:
1. Contractor's Qualification Statement - AIA A305 Current edition (copies available from the AIA, www.documentsondemand.AIA.org) setting forth previous experience, references, physical plant and equipment possessed, description of organizations, financial resources, conformance with special requirements, qualification statement and such other evidence as may testify to his ability to carry out the contract..
 2. List of Job References for minimum 5 similar (type/size) projects with current contact names and phone numbers providing company experience.
 3. Resumes of key personnel including Project Manager and Project Superintendent providing individual's name, address, current driver's license or legal photo I.D, trade classification, years of trade experience and years employed by contractor.
 4. Equipment list providing physical plant and equipment possessed.
 5. Other such evidence as may testify to the Contractor's ability to carry out the contract.

4.02 SPECIAL REQUIREMENTS

- A. All Contractors and Sub-Contractors shall comply with the following conditions:
1. The main office of all Contractors, Sub-Contractors, and other bidders shall be located within approximately a fifty (50) mile radius from the job site.
 2. The Contractor and their Sub-Contractors shall give preference to using local firms for labor and materials where practical without sacrificing the quality, time schedule and cost of the project. Local is defined as that available within the boundaries of Monroe County.
 3. The Owner expects the Contractor to utilize local Sub-Contractors and suppliers when all other factors are similar and when it would serve the Owner's best interest. Other factors that will be used in awarding a contract include cost, past projects and performance, time schedule, qualifications, credit/financial history, bonding capability, etc.
 4. Contractor's Qualifications:
 - a. Experience - The Prime Contractor shall have been in business under its present name and ownership for the last five (5) years. The Prime Contractor shall have completed a minimum of five (5) projects similar to this project, in type and size, using the materials and manufacturers as herein specified.
 - b. Personnel - The Prime Contractor shall have a minimum of (3) regular full-time employees (Estimators, Superintendents, Laborers, etc.) on his company payroll that are qualified with the appropriate skills to perform the work specified. This excludes Owners/Officers of the company.
 - c. Project Superintendent - Shall be sufficiently experienced to coordinate and be responsible to direct all workers and Sub-Contractors in the installation of the work and for taking instructions from the Owner/Architect. **The Project Superintendent shall be on the job site at all times that construction is in progress.** He shall also be responsible to up-date an accurate "As-Built" drawing of all trades on a daily basis to be submitted to the Architect at job completion.
The same Superintendent shall remain on the job from beginning to end, unless written approval is given by the Architect, in advance. This is to avoid additional costs the Owner will incur should the Architect have to repeat directives, review changes, or any other additional services required to get the replacement Foreman educated with the project's details and scope.
 - d. Franchised Installer - The Prime Contractor, or any Sub-Contractor shall be franchised and approved by the manufacturer of the components, or system, which is

to be installed for the last five (5) years. Contractor shall submit a letter from the component manufacturer, stating this Contractor's previous performance rating of installation of the component on the last ten (10) completed projects.

- e. Equipment - The Prime Contractor shall possess sufficient equipment, tools, safety items, etc., to properly install the work and to ensure the necessary security and safety of the job site, the workers and the occupants.
5. As all of the above items are essential conditions for awarding a contract, the three lowest bidders shall submit the following required items no later than twenty-four (24) hours following the bid opening:
- a. Finalized Sub-Contractor list with each worker's name, address, social security number, trade classification, years of trade experience and years employed by Sub-Contractor. See other Divisions of these specifications that may set ratios of apprentices to journeymen.
 - b. Anticipated material supplier list.
 - c. Guaranteed Maximum percentage of mark-up values on change orders including Overhead, profit, bond, insurance, wage rates, and equipment rates for BOTH prime contractors and subcontractors.

If the Owner awards a contract, sub-contractors shall not be changed by the Contractor unless approved in writing by the Owner. Request for changes shall be submitted by the Contractor, stating the reason(s) for the change, along with all supporting documentation.

- 6. Any bidder not in agreement or conformance with these conditions shall request a waiver at the time of submitting the bid. Otherwise if a contract is awarded to a Contractor not requesting a waiver, the Contractor will be required to conform as specified.
- 7. The contractor shall not employ and shall not subcontract with a subcontractor of any degree that employs, an individual required to be registered under Article 2 of 1994 PA 295, as amended, who will be assigned to work within a student safety zone, as that term is defined in 1994 PA 295, as amended.

Neither the contractor nor subcontractor thereof of any degree shall assign to the Owner's Project any individual, and the Owner shall not allow any individual, to regularly and continuously work under contract in any of the Owner's schools if the reports on an individual's criminal history or criminal records check have not been received or if those checks would disclose or do disclose that individual has been convicted of a felony other than a "listed offense" as that term is defined in Section 2 of the Sex Offenders Registration Act, 1994 PA 295, as amended, or which disclose that individual has been convicted of a felony other than a "listed offense" unless the Superintendent and the Board of the Owner each specifically approve of the work assignment in writing. Additionally, the contractor agrees that it shall not assign any of its employees, agents or other individuals to perform, and shall not permit any of its subcontractors to assign personnel to perform, any services under this Agreement where such individuals would regularly and continuously work in the school district's facilities or program sites if such person has been convicted of any of the following offenses:

- a. Any "listed offense" as defined under Section 2 of the Sex Offenders Registration Act, MCL 28.722; or
- b. Any offence that would, in the judgment of the Board, create a potential risk to the safety and security of students served by the school district or employees of the school district; or
- c. Any offense enumerated in Sections 1535a (1) or 1539b of the Revised School Code, MCL 380.1535a(1) or MCL 380.1539b; or
- d. Any offense of a substantially similar enactment of the United States or another State.

Any personnel of the contractor or of the subcontractors thereof of any degree that have been charged with any of the above-referenced crimes shall immediately report that circumstance to the Owner's superintendent and shall not be permitted to work in any of the schools of the Owner during the pendency of the prosecution associated with such charge(s). The Owner reserves the right to refuse contractor's assignment

of any individual, agent or employee of the contractor or subcontracted personnel of any degree to render services under this Agreement where the criminal history of that individual (including any pending charges) indicate, in the school district's judgment, unfitness to perform services under this Agreement. Violation of the above by the contractor or a subcontractor thereof shall be a basis for immediate termination of this Agreement. The contractor shall require language similar to the above in all of its agreements and/or contracts with its consultants, subcontractors, suppliers and materialmen of any degree.

8. Any and all personnel of the contractor, any subcontracted personnel, and/or any suppliers thereof of any degree, assigned to regularly and continuously work under contract in any of the Owner's schools shall be required to submit a signed Conviction Disclosure Form and a legal photo identification for a background check before being allowed on the construction site. (Copy of form included at end of this Division).
9. Contractor shall submit a signed and notarized copy of the Statement Regarding Familial Relationship with his Bid Proposal. (Copy of form included in bid specification packet.)
10. Contractor shall submit a signed and notarized copy of the Affidavit of Compliance Iran Economics Sanctions Act with his Bid Proposal. (Copy of form included in bid specification packet.)

BID SUBMISSION

5.01 DEPOSIT AND OPENING OF BIDS

- A. Proposals shall be submitted and delivered in opaque envelopes addressed to **Bid Location** and clearly marked **Proposal**. There shall also appear name and address of the bidder.

5.02 PREPARATION OF PROPOSALS

- A. Proposals shall be prepared only on the form provided by the Architect, and all spaces left for the purpose shall be fully filled in. All designations and prices shall be fully and clearly set forth, with the amount of the bid stated in words and repeated in figures. In case of variations the worded amount shall prevail. Erasures or other changes in the bid shall bear the signature of the bidder. Proposals must be signed.
- B. The bids shall be on the basis of guaranteed sum. Bidders should not add any conditions or qualifying statements, the proposal shall not contain any added recapitulation of the work to be done nor will oral, electronic or telephonic modifications of the work be considered, as otherwise the proposal may be declared irregular.

5.03 BID PROPOSAL CLARIFICATIONS

- A. Bidders shall submit prices for each proposal, alternate, unit price, or other requested bid amount. Bidders may elect not to bid the Alternate prices but may jeopardize their chances of being awarded a contract. The Owner has the right to award contracts to the bidder on the basis of any combination of base bid and alternate plus any unit prices or other bid amounts that best serves the Owner's best interest.
- B. The alternate numbering system does not reflect any priority. The Owner may select and award a contract on the basis of which alternates are in their best interest.
- C. In the case where several separate Base Bid Proposals are requested, the Owner may award contracts on the basis of these proposals or a combined bid, to one Contractor or several Contractors, whose bid(s) serves the Owner's best interest. If the Base Bids are an either/or selection, the Owner may choose the Proposal (Base Bid or Optional Bid) that serves their best interest.

BID ENCLOSURES/REQUIREMENTS

6.01 BID GUARANTEES

- A. No proposal will be considered unless it is accompanied by the bid guarantees as stated in the official Advertisement for Bids. Guarantees may be in the form of a certified check or a standard form of bid bond by a corporate surety licensed to underwrite bids in the State of

Michigan (facsimile copies are not acceptable). Guarantee shall be in the amount of five percent (5%) of the amount of the bid submitted, or in the case of separate and combined bids, five percent (5%) of the total of the separate bids. Amount shall include Base Bid plus all Alternates. Guarantees shall be drawn in favor of the Owner.

6.02 RETURN & FORFEITURE OF BID GUARANTEES

- A. The bid guarantees of all except the three lowest Bidders will be returned within fifteen days after the opening of bids. The guarantees of the three lowest bidders will be returned within three days after the executed contract and bonds have been finally approved by the Owner.
- B. In the event of the successful bidder refusing to enter into contract, or failing to execute the contract and bonds within ten (10) days after formal notification of award of contract, then a sum not to exceed five percent (5%) of the amount of the bid shall be forfeited to the Owner due to lack of performance and as liquidated damages.

OFFER ACCEPTANCE/REJECTION/WITHDRAW

7.01 RIGHT RESERVED BY OWNER

- A. The Owner reserves the right to waive any irregularities, reject any or all bids, or accept the bid that in the opinion of the Owner will serve the best interest of the Owner. The Owner also reserves the right to reject the bid of any bidder who has previously failed to perform properly, or to complete on time contracts of a similar nature, or who is not in a position to perform the contract, or who has habitually and without just cause neglected the payment of bills or otherwise disregarded his obligations to Sub-contractors, Material Men or Employees.
- B. The ability of a bidder to obtain a performance bond shall not be regarded as the sole test of such bidder's competency or responsibility.

7.02 ACCEPTANCE OF OFFER

- A. After acceptance by Owner, Architect on behalf of Owner, will issue to the successful bidder, a written Notice To Proceed.

7.03 WITHDRAW OF PROPOSALS

- A. Any bidder may withdraw his bid at any time prior to the hour and date specified for openings. No bidder may withdraw his proposal for **Sixty (60) days** thereafter. Negligence on the part of the bidder in preparing his bid confers no right of withdrawal or modification of his bid after such bid has been opened.

ARCHITECT'S SERVICES

8.01 ARCHITECT'S BASIC SERVICES

- A. The Architect will schedule and conduct a pre-construction meeting before work starts.
- B. The Architect will make job site visits on a scheduled basis (or) on a random basis, (approximately one per week), during the course of construction. He shall be provided with access to all areas of work to ensure construction is proceeding in accordance with the contract documents. The Contractor shall schedule all sample mock-ups, questions regarding the project, any special meetings for Architect's review and approval during this visit.
- C. The Contractor is responsible to notify the Architect 48 hours in advance for the following special visits:
 - 1. First day of job set-up to review material storage placements & general layout
 - 2. All excavations prior to backfill or concrete placement & during testing, after demolition, but before new materials are installed, to view concealed job conditions.
 - 3. To review/approve all samples of construction before Contractor continues with the work. Sample areas may be described in other Divisions of the Specifications - this may also include special visits by manufacturers of systems.
 - 4. When observations/reviews/approvals are made by representatives of Manufacturers and Suppliers
 - 5. The Contractor shall submit a notice of completion letter to the Architect in writing when all work is complete and ready for a punch list. Under the normal services, the Architect will

make (1) punch list visit, (1) re-punch and (1) random final check. The initial punch list will be made by the Architect in the presence of the Contractor and the Owner to determine what items may need corrections and if the project is substantially complete. One week's advance notice is required.

The punch list will be written up by the Architect and describe general and/or specific items in general locations. It is the Prime Contractor's responsibility to also make a list of his own, dealing with the specifics and translate them to the proper Sub-Contractors.

If the Architect arrives at the job site and the project is not done and ready for a punch list, but rather a "to do list", the Architect has the right to leave and will only return when notice of completion is again received in writing. This process will use up (1) of the normal punch/re-punch visits.

The first re-punch and the final random re-punch visit shall again be requested in writing, similar in format to the initial punch list.

6. The punch and re-punch list include physical items in the field requiring completion, as well as paperwork items that must be submitted prior to job "close-out" and "final completion" as noted in the General/Special Conditions. Final payment can only be considered once all items are completed to the satisfaction of the Owner/Architect.

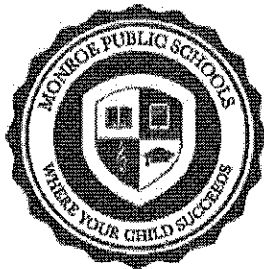
8.02 ARCHITECT'S ADDITIONAL SERVICES

- A. The contractor should review the special conditions for any applicable liquidated damages that apply for failure to meet "substantial" or "final completion" dates. In addition to these costs, or in the event that liquidated damages are not part of this contract, the contractor is responsible to reimburse the owner for the direct costs incurred for additional time by the architect, administrative/custodial staff, attorney, etc., when the project goes beyond the established dates and the cause of the delay is not beyond his control.
- B. The Contractor will be responsible to pay for all additional Architectural services, including all special visits requested by the Contractor to resolve problems that are due to the lack of performance by the Contractor. Examples of certain circumstances which will cause the Contractor to incur additional Architectural service fees include, but are not limited to the following:
 1. Shop drawing submittals that are rejected due to being incomplete or for submitting on materials other than as specified and noted on the Bid Proposal Form.
 2. Contractor elects to use more than (1) Sub-Contractor for any trade that results in duplicate shop drawing submittals.
 3. Contractor requests a punch list in writing and Architect finds the work incomplete.
 4. If the Contractor fails to complete all punch list items within the (3) punch/re-punch visits allowed, the costs for all additional punch list visits will be deducted from the final cost amount due to the Contractor to cover any Architect's, Owner's, or Attorney's additional services at their regular billing rate until the work is accepted by the Architect and Owner.
 5. Contractor installs other than approved materials, resulting in additional time incurred by Architect.
 6. Contractor changes job Foreman or fails to have job Foreman present on job when visited by the Architect, which requires Architect to educate new Foreman to job status or repeat instructions.
 7. Contractor's layout or installation is found to be significantly different than the design or shop drawings and the Architect is required to review, approve, or make extensive revisions.
 8. Contractor's failure to promptly correct or make good any problem that is part of this contract work and falls under the Contractor's responsibility to properly work as intended, either during the course of construction, or during the close-out period, all of which requires additional time by the Architect for reviews, observations, etc.
 9. All Architect's/Engineer's time to close out the project beyond the thirty (30) days after substantial completion, including making phone calls, writing letters, reviewing documents,

special close-out meetings, etc., unless a time extension has been approved with a signed change order.

10. Note: All additional time required by the Architect to resolve any of the above items will be back charged against the contract amount based on the Architect's/Engineer's current hourly rate and made payable to the Architect by the Owner. The Contractor shall be informed by the Architect within ten (10) days of any incident of any intent to invoke back-charges for additional Architectural services. It shall be the Contractor's responsibility to request in writing any estimates of additional costs to be incurred. Contractor's failure to respond to the estimate in a timely manner will be interpreted as Contractor's acceptance of all additional Architectural services for back-charges as summarized by the Architect.

END OF SECTION



Monroe Public Schools Conviction Disclosure Form – New Employees

I UNDERSTAND THAT THE INFORMATION REQUESTED IS REQUIRED BY THE CENTRAL RECORDS DIVISION OF THE MICHIGAN STATE POLICE, LANSING, MICHIGAN. I FURTHER UNDERSTAND THAT A CONVICTION RECORD DOES NOT NECESSARILY PREVENT ACCEPTANCE OF EMPLOYMENT. I AUTHORIZE MONROE PUBLIC SCHOOLS TO UTILIZE THE ABOVE INFORMATION FOR THE PURPOSE OF OBTAINING INFORMATION REGARDING A CRIMINAL CONVICTION.

Name: _____

Last _____ First _____ Middle _____

Maiden name or names previously used: _____

Birthdate: _____ Race: _____ Sex: _____

Building: _____ Assignment: _____

Pursuant to Public Act 138 of 2005, I represent that (check all that apply):

_____ 1. I have not been convicted of, or pled guilty or nolo contendere (no contest) or am the subject of a finding of guilt by a judge or jury of any crime.

_____ 2. I have been convicted of, or pled guilty or nolo contendere (no contest) or am the subject of a finding of guilt by a judge or jury for the following crimes (*attach a separate sheet of paper to explain the criminal offense, date, court, city/state, and circumstances surrounding the conviction*):

Felony _____ Misdemeanor _____

Felony _____ Misdemeanor _____

Felony _____ Misdemeanor _____

In signing this form, I understand and agree that:

3. If I have been convicted of a listed offense, my employment shall be terminated. I also understand that if I have been convicted of a felony, other than a listed offense, the superintendent, or chief administrator and the School Board must each approve, in writing, my employment or work assignment.
4. Until the criminal history report is received and reviewed by the employing school district, I am regarded as a conditional employee and if the criminal history report is not the same as my representation(s) above, my employment contract is voided at the option of the school district.

Signature _____

Date _____

**SECTION 007400
SUPPLEMENTARY AND SPECIAL CONDITIONS**

PART 1 GENERAL

1.01 CONTRACTS, BONDS AND INSURANCE

A. Contract

1. The Architect will prepare the AIA Document A101-2017, Standard Form of Agreement Between the Owner and Contractor based on the bid amount agreed by the Owner. Successful bidders will be required to furnish bonds and insurance in accordance with the provisions of the General Conditions. Executed duplicate copies of bonds and insurance certificates will be required for each set of contract documents. On this project the Owner elects not to require "Project Management Protective Liability Insurance".
2. All conditions of all contract and sub-contracts for labor and material to be furnished on this work shall be as set forth in the General Conditions for Building Contracts, Form A-201-2017, latest edition of the American Institute of Architects. Where there is a difference between this project manual and Form A-201, this project manual shall govern. All Contractors and Sub-Contractors shall familiarize themselves with all conditions of this form and be bound by them. (Copies available from the AIA, www.documentsondemand.AIA.org, at cost.)

B. Guarantee Bonds:

1. Article 11.5 of the General Conditions shall be supplemented as follows:
 - a. "Prior to signing the contract, Contractor shall pay the premium for and furnish Performance Bond in the full amount of the contract price to cover faithful performance of the contract, and a Labor and Materials Bond in full amount of contract price to cover payment of all obligations arising thereunder. Bonds shall be in such form as Owner may prescribe and with such sureties as he may approve."

C. Insurances:

1. Article II of the General Conditions shall be supplemented as follows:
 - a. "Insurance shall be written for amounts as required by law or not less than the following limits of liability" for personal and property losses:

General Aggregate	= \$2,000,000.00
Product and Completed Operations Aggregate	= \$2,000,000.00
Personal & Advertising Injury	= \$1,000,000.00
Each Occurrence	= \$1,000,000.00
Medical Expense	= \$ 5,000.00
Automobile - Owned/Non-Owned	= \$ 1,000,000.00
 - b. The Owner shall provide and pay the premium for Owner's liability and builders risk insurance.
 - c. Contractor shall provide certificates of coverage for necessary unemployment insurance, workman's compensation, etc., as required by the State of Michigan and the Federal Government.
 - d. Contractor shall provide and pay the premium to add the Owner and Architect as additional insured to the insurance coverage for this work (See this section for Hold Harmless / Indemnify). (This is to cover any claims against Owner/Architect due to Contractor's negligence.)
 - e. Only Certificates of Insurance Certified using Accord Form #25-S (7-90) will be acceptable. All insurance shall be carried with companies authorized to do business in the State of Michigan and which are satisfactory to the Owner. See sample certificate at end of "Instruction to Bidders".
 - f. The insurer shall agree to notify the project Owner prior to termination, or reduction of any insurance coverage. The certificate shall include the following statement, "30 Day Notification in Case of Cancellation", and shall contain no disclaimers.

- g. The Contractor shall require his Sub-Contractors who are not protected under his liability and workman's compensation insurance to purchase and maintain their own insurance of the same types and limits as is required of the Contractor.

1.02 EXAMINATION OF SITE, MEASUREMENTS & LEVELS:

- A. Bidders shall visit the site of the work, compare the drawings and specifications with any work in place, and inform themselves of all conditions, including other work, if any, being performed. Failure to visit the site will in no way relieve the successful bidders from the necessity of furnishing any materials or performing any work that may be required to complete the work in accordance with the contract documents without additional cost to the Owner.
 1. Each Contractor shall be responsible for the correct installation of his work to comply with the plans and specifications.

1.03 GENERAL CONTRACT

- A. Local Labor & Materials - Each Contractor shall give preference to the employment of local labor and the purchase of materials locally where same are available at prices equivalent to those obtainable elsewhere.
- B. Current Laws - The Contractor shall keep himself fully informed of all laws and municipal ordinances and regulations in any manner affecting those engaged or employed in the work, and all orders and decrees of bodies or tribunals having any jurisdiction or authority over the same. He shall, at all times, observe and comply with all such current laws, ordinances, regulations, orders and decrees which are effective during the progress of the work; and shall protect and indemnify the Owner and its officers and agents against any claim or liability arising from or based on the violations of any such law, ordinances, regulation, order or decree, whether by himself, his Sub-contractors, or his employees.
- C. Collusion - If at any time it shall be found that the person, firm, or corporation to whom the contract has been awarded has, in presenting any bid or bids, colluded with any other party or parties, then the contract so awarded shall be null and void, and the Contractor and his sureties shall be liable to the Owner for all loss or damage which the Owner may suffer thereby and the Owner may advertise anew for bids and said work.
- D. Responsibility - The Contractor is primarily responsible for all work. He shall coordinate all Suppliers, Sub-Contractors, etc., that he may contract work with. He shall notify all Sub-Contractors in advance to avoid any unnecessary delays. The Contractor shall assume responsibility for the general charge and security of the building within the contract limits until it is accepted by the Owner. Contractor shall be responsible for maintenance of his work until final acceptance by Owner, and shall take such measures as necessary to ensure adequate protection of equipment and materials during delivery, storage, installation, start-up, temporary operation and shut-downs and any damage, vandalism, thievery, etc., to stored, or installed materials or any part of this construction.
- E. General/Prime Contractor's Responsibility - It is the General Contractor's responsibility to provide and install all items specified in this contract, to assemble and collect all parts, materials, equipment, labor, etc. as required for a complete finished installation. Where these documents state, for clarification purposes that the work or item is to be completed by certain trades or Sub-contractors, (i.e. Mechanical or Electrical Contractor), it shall be referenced only to those related divisions. These specifications and drawings do not control the Contractor in dividing the work among his workers, Sub-contractors, suppliers, etc., or in establishing the extent of work to be performed by any trade.
- F. Lay Out - The Contractor shall immediately locate all general reference points and take such action as is necessary to prevent their destruction; lay out his work and be responsible for all lines, elevations and measurements of buildings, grading, paving, utilities and other work executed by him under the contract. He must exercise proper precautions to verify figures shown on drawings before laying out work and will be held responsible for any error resulting from his failure to exercise such precaution.

- G. Cooperation & Courtesy - There must be complete co-operation between all Contractors, as well as between Contractor and Sub-Contractor, to insure satisfactory performance of all work. Foul language, alcoholic beverages and illegal or controlled substances/drugs will not be allowed by anyone under the control of this Contractor. Tobacco usage will also not be allowed where prohibited by law or by the Owner's wishes/policies. Courtesy must be exercised towards the owner, their staff and customers, deliverymen, etc., at all times.
- H. Skilled Labor - All labor on this project shall be done by skilled mechanics, qualified and competent to perform the best grade of workmanship in the trade of work being performed, such as a Roofer shall not perform finish carpentry or drywall work in an exposed location. Each Contractor and Sub-contractor shall provide a competent foreman at the job, who shall be responsible for taking instructions from the Architect and directing and installation of the Contractor's work.
- I. Equal Opportunity - It shall be understood that the Contractor shall comply with the State Policy of Equal Employment Opportunity established by the Michigan Civil Rights Commission. The following Civil Rights Laws must be conformed to:
1. Title VI of the Civil Rights Act of 1964, as amended, 42 U.S.C., Section 2000d et seq., which prohibits discrimination on the basis of handicap in programs and activities receiving Federal financial assistance
 2. Section 504 of the Rehabilitation Act of 1973, as amended, 29 U.S.C., Section 794, which prohibits discrimination on the basis of handicap in programs and activities receiving Federal financial assistance.
 3. Title IX of the Education Amendments of 1972, as amended, 20 U.S.C., Section 1681 et seq., which prohibits discrimination on the basis of sex in education programs and activities receiving Federal financial assistance.
 4. The Age Discrimination Act of 1976, as amended, 42 U.S.C., Section 6101 et seq., which prohibits discrimination on the basis of age in programs or activities receiving Federal financial assistance.
- J. Hold Harmless/ Indemnify Clause - The Contractor agrees to comply with all laws and regulations applicable to the work to be performed and will indemnify, defend and save harmless the Owner and Architect and said property from damage which may arise as a result of the work performed and list each on certificates of insurance as additional insured, if Project Management Protective Liability Insurance is not provided.
- K. Shop Drawings & Data Sheets - Submit shop drawings per 013000 - Administrative Requirements for review by the Architect. A copy of all shop drawings shall be kept at the job site by the Contractor. The Contractor shall review and stamp approved, note changes, etc., before submitting to the Architect.

Shop drawings are not contract documents. Their purpose is to demonstrate the way the Contractor proposes to conform with the information given on the Architect's drawings. Shop drawings shall be submitted on all pre-manufactured items, custom fabricated components, any individual component that fits with or into another component to form the entire assembly, or on items specifically specified in certain divisions.

The Contractor, his Sub-Contractor and Supplier shall be responsible to determine and verify all materials, field measurements and field construction data, prior to submittal to the Architect. The Architect's review is only for the limited purpose of checking conformance with information given and the design concept expressed in the contract documents. The Architect's review is not conducted for the purpose of determining the accuracy and completeness of details, such as dimensions, quantities and the assembly of specific components to work as a whole. The Architect is also not responsible for any safety precautions, construction means, methods, techniques, sequences or procedures.

It shall also be the responsibility of the Contractor, his Sub-Contractor or Supplier to work from a full set of contract documents in preparation of the shop drawings, so that each part or component will work with those parts as furnished or fabricated by others, so that the assembled whole works together as intended.

Shop drawings shall be submitted to the Architect early enough to allow adequate ordering, fabricating and delivery to the job site. Once received by the Architect the shop drawings will be returned to the Contractor in a timely manner. For estimating purposes and fitting into the job progress construction schedule, the following estimates of time may be used: Engineered reviewed drawings - 14 days; in-house Architectural reviewed drawings 7-10 days. Failure by the Contractor to submit enough in advance to the Architect in no way relieves the Contractor from completing the work in the time frame specified. The Contractor relieves the Architect of all responsibility and liability should he proceed with construction, fabrication or delivery of the specified part(s) without obtaining the Architect's review first.

Data sheets, manufacturer's specifications, picture cuts, etc., shall be submitted for all materials proposed to be used in this contract. All materials shall be asbestos free, 100%. No use of any materials, glues, sealants, gaskets, etc., containing any trace of asbestos shall be used on this project. Data Sheets shall clearly state the product's composition, or that no asbestos is used.

All finish materials and/or their adhesives for securing to substrates, shall meet the A.D.A. (American Disability Act), as passed July 1990 and revised September 15, 2010 to regards to elimination of toxic/allergic chemical contamination via direct vapors/fumes, or when in contact with normal spilled materials and cleaning agents.

Submit at the beginning of the project an index sheet listing all proposed shop drawings to be submitted.

- L. As-Built - The Contractor shall keep an accurate record of all deviations from the contract drawings and specifications. He shall neatly and correctly enter in pencil any deviations on the drawings affected and shall keep drawings available for inspection. Extra set of transparencies will be furnished for this purpose. Submit As-Built per 013000 - Administrative Requirements and 017000 - Execution and Closeout Requirements for review by the Architect.
- M. Manuals & Brochures - The Contractor shall submit per 013000 - Administrative Requirements and 017000 - Execution and Closeout Requirements to the Architect at completion, maintenance manuals, instructions, parts, etc., of all items installed as part of this work. Include all warranties, application for extended warranties, etc. These items shall be submitted as shop drawings.
- N. Debris - All rubbish resulting from the work herein specified shall be removed from the premises as fast as it accumulates.

1.04 DEFECTIVE WORK & GUARANTEE:

- A. The Contractor shall maintain his work in good condition, and repair at his own expense any work or material which proves to be defective within one (1) year from the time of final payment. A specific time can be determined towards the end of job, but it is estimated as approximately thirty days after substantial completion. This shall not be construed to cover misuse or abuse. Submit the guarantee in writing to the Architect upon completion. Specific material, equipment, or special trade warranties and guarantees as noted in these specifications shall also be submitted in writing. All warranties shall be written using the format and language as in sample warranty listed at the end of this section. Included, but not limited to, shall be the following:
 - 1. All Sub-contractors shall submit a signed written warranty same as the general contractor.
 - 2. All warranties shall be addressed to the Owner, on Company's letterhead.
 - 3. All equipment warranties shall start from date of project substantial completion in the phases noted – not the dates the equipment was installed or started up.
 - 4. All work under this contract, in addition to the roof, shall be watertight and leak proof throughout at every point, and in every area, for a period of (1) year from date of final payment, except where leaks can be attributed to damage caused by external forces beyond the Contractor's control. The Contractor shall immediately, upon written notification by the Owner, respond to the site to determine the source of water penetration and if found to be caused from faulty materials/workmanship resulting from this contract, repair or replace the item(s) or do any other work necessary to make watertight at his own expense.

5. Contractor shall also, at his own expense, repair or replace, or reimburse the Owner for any damaged materials, finishes, and furnishings/contents damaged as a result of this water penetration, in order to return the premises back to the same condition prior to the water penetration.
 6. In addition to the warranties as stated in this manual, the Contractor shall comply with all other warranties referred to in any portions of the contract documents or otherwise provided by law or in equity, and where warranties are in conflict, the more stringent requirement shall govern.
- B. Neither the final certificate nor payment shall relieve the Contractor of responsibility for lack of conformance to the contract documents, lessening the quality of specified work or scope, errors, negligence, faulty materials or faulty workmanship within this contract, the period provided by law at the location of this project, or any special equipment/material warranties.
 - C. The Contractor shall bear the cost of correcting mistakes, which by a reasonable check he could have avoided.
 - D. The Contractor shall promptly remove from the premises all materials, whether worked or un-worked and take down and remove all portions of contract work demanded by the Architect or his representative as failing to conform to the contract.
 - E. The Contractor shall promptly replace and re-execute the work in accordance with the contract and shall bear expense of same, together with the expense involved in making good all work of other Contractors destroyed or damaged by each removal or replacement. If the Architect deems it expedient to accept work injured or not done in accordance with the contract, the difference in value, making a full allowance for damage, shall be deducted from the contract sum if acceptable to the Owner.
 - F. Each Sub-Contractor shall warrant that all work installed by his company, including that movable or adjustable, shall remain in good working order and agrees to remedy and correct and place in proper operating condition all such found not in good working order during the period of warranty unless such work has been abused or neglected by the Owner.

1.05 DEFINITIONS:

- A. Architect - Shall be interpreted to mean **Kohler Architecture, Inc.**, or his authorized representative.
- B. Contractor - Shall be interpreted to mean the Prime Contractor who has a direct contract with the Owner. (assumed General Contractor)
- C. Owner - Shall be interpreted to mean **Monroe Public Schools**
- D. Sub-contractor - Shall be interpreted to mean any person or entity who has a direct contract with the Prime Contractor, either supplying labor or materials.

The Prime Contractor shall employ only (1) Sub-Contractor/Supplier for each trade/category of work for the entire contract, or in the case of multiple building/sites, (1) Sub-Contractor/Supplier in each trade/category for all sites/buildings. This improves coordination and project scheduling, reduces shop drawing and payroll reviews, and standardizes materials and installation.
- E. Substantial Completion - Shall be defined to mean when the Architect establishes in writing, based on his knowledge, observations and beliefs, that all necessary components are installed for the project to be acceptable for the Owner's intended use and beneficial occupancy, including the Contractor obtaining governing agency approvals (City, Township, County, and/or State) on all permits issued on this project. The project must meet substantial completion no later than the date established elsewhere, unless amended by change order.
- F. Final Completion - Shall be defined to mean when all work, including completion of all punch list items, paper work has been submitted (guarantees, final waivers, as-builts, etc.) and the Architect approves the Contractor's final certificate for payment.

1.06 SPECIAL CLARIFICATIONS:

- A. Manufacturer's Specifications - All materials, items, equipment, etc., shall be installed in accordance with the manufacturer's specifications and recommendations when not otherwise specified. These specifications do not replace or override any installation manuals/directions. The installer shall provide all materials and perform all work that is needed for this application, whether specialized to this installation or not, as required and/or recommended by the manufacturer so as not to void any warranties and functions properly so that each component becomes part of the entire assembly.
- B. Where a material or installation is specified in these specifications and is in conflict with manufacturer's recommendations, the Contractor shall immediately notify the Architect before proceeding with the work. Failure to do so will place full responsibility upon the Contractor performing the work.
- C. Methods of Construction - The Contractor takes full responsibility and liability for the means and methods of construction to perform the work under this contract. The timing, scheduling and skill of workers and suppliers shall be coordinated prior to beginning any work. The type of equipment, installation, sequence, temporary provisions, etc., all as required to produce the finished product for a first-class installation shall be determined by the Prime Contractor. Any delays, errors, omissions or any other problems caused to the job by a change in Sub-contractors or suppliers, bad scheduling, lack of supervision, material deliveries, etc., shall be borne by the Prime Contractor.
- D. Changes - These drawings and specifications are provided to give the Contractor an understanding of the systems and materials to be installed under this contract. Where the scope of work or details are in conflict with job conditions, the manufacturer's specifications, manufacturer's guarantee, etc., they shall be modified as required by the Contractor. The Architect shall be notified prior to any change. When these details exceed the manufacturer's requirements and the guarantee, no change shall be made, unless so directed by the Owner or Architect, and the work shall be performed in strict accordance to these drawings and specifications.

When a change is initiated either by the Owner, Contractor or Architect, the Contractor shall submit a cost breakdown of the change for approval by the Architect and Owner, before proceeding with the work. Any change in completion date shall also be documented. A formal Change Order, signed by the Owner, Contractor and the Architect will follow to authorize the work to be done and the contract amount and/or completion date to be changed. A Change Order must be fully executed before including on pay requests.

- E. To insure the intent of the contract documents are being complied with and since the Architect is not providing full time inspection/observation services, the Contractor shall perform the following:
 - 1. On all demolitions, removals, excavations or existing concealed conditions, the Contractor shall certify that conditions found were as anticipated, or as specified in the contract documents. If the above conditions are closed-up, covered, or back-filled prior to notifying the Architect or prior to his scheduled inspection, the Contractor shall document with photos, measurements and/or sketches how the concealed conditions were constructed.
 - 2. Should the Contractor become aware of any deviations, unusual circumstances, cause for extra work, or other reasons he feels may have an effect, or cost change on this contract, he shall immediately notify the Architect for directions.
 - 3. Contractor's failure to notify the Architect/Owner, prior to performing the additional work, accepts full responsibility for any extra costs, delays or non-acceptance by the Owner or Architect that may be produced or incurred to the contract.
- F. Discrepancies - Should the contract documents disagree (drawings and specifications), the better quality or larger quantity of materials or work shall be included in the bid and unless otherwise ordered in writing, shall be furnished by the Contractor.
- G. Standard Codes - Reference made to standard specifications or codes refer to latest edition unless otherwise noted. Such reference includes current addenda and errata, if any. All work

shall meet or exceed all zoning and code requirements, including the current Michigan Building Code, or as adopted by the local building authority, and State Fire Marshal.

- H. Organization - The organization of the specifications into Divisions, Sections and Articles, and the arrangement of drawings shall not control the Contractor in dividing the work among Sub-contractors or in establishing the extent of work to be performed by any trade.
- I. Materials - Shall be new. Seconds or damaged materials will be rejected by the Architect, who reserves the right to disapprove and reject any materials proposed or installed, which in his opinion fail to meet quality standards specified. Contractor shall, at his expense, remove and replace with approved materials, any rejected materials.
- J. Labor - As noted elsewhere, it is the Prime Contractor's responsibility to keep the job moving according to the progress schedule and meet completion dates specified or stated in the Bid Proposal. Whether Workers/Sub-Contractors/Suppliers are union or non-union, default, quit, fail to perform, it is the Prime Contractor's responsibility to work out problems that may occur to keep on schedule and prevent any damages, delays, or disturbances caused to the Owner and/or job site.

1.07 DAMAGE & REPAIRS TO SITE & BUILDING:

- A. The site, building and furniture or equipment, including such items as walls, ceilings, floors, roofs, trees, drives, walks, curbs, gutters, paving, grade areas, etc., cut up or damaged during construction of this project shall be repaired or replaced in a neat and workmanlike manner, to the satisfaction of the Owner and Architect, by the Contractor responsible.
- B. The Contractor shall be responsible for the security, water tightness and systems operation of the building in areas of this work. Any vandalism, water damage, theft, electrical/mechanical damages, etc., to the building or its components or any stored or installed materials as part of this work, or furniture and equipment (ceilings, floors, walls, desks, computers, books, papers, etc.) shall become the Contractor's responsibility to restore (replace or repair) all items to their same condition as when the work started. Included, but not limited to, shall be all additional costs for Architects, Attorneys and Owner's staff time to clean up, document and resolve any damages or issues.

1.08 PROGRESS PAYMENT:

- A. Owner shall make payments on account, upon issuance of certificates of payment by the Architect, for labor and materials incorporated in the work and for materials suitably stored at the site, up to ninety percent (90%) of the value thereof. Properly documented invoices shall be submitted for all stored materials. Pay requests shall reflect only the work stored or completed at date of submittal to the Architect. No projections of cost for anticipated work beyond the submittal date will be allowed.
- B. Payments shall stop at 90% of the total contract, until project is SUBSTANTIALLY COMPLETE (Owner's use) and until governing agency (Governing Building Authority) has given approval. (See Substantial Completion definition in Section 1.1D-5)
- C. Final payment will be made when the work is FULLY PERFORMED and FINAL COMPLETION is achieved.
- D. Certain specialty construction projects are subject to other payment conditions, such as re-roofing, re-paving, etc. (see Special Payment Conditions at end of this Division, if applicable).
- E. Also see Instructions to Bidders for any other requirements.

1.09 LABOR RATES

- A. State Funded Projects
 - 1. On all State projects or state funded projects, the contractor shall abide by the minimum wage rates, employment standards, occupational classifications, etc., as issued by the State of Michigan, Department of Labor and Economic Opportunity, Wage and Hour Division.

1.10 TIME OF COMMENCING & COMPLETION:

- A. Contractor, upon award of contract, shall begin immediately to order materials so work can begin with no delays in material deliveries.
- B. All auxiliary Sub-contractors (Electrical, Carpentry, etc.) performing work under this contract at same time that Contractor is doing work, are obligated to commence, carry on, co-ordinate and complete their work in the various stages, so that the whole job will be accomplished in a scheduled manner and so that the Prime Contractor will be able to complete his work within completion time fixed.
- C. To assure that all materials are placed on order and their delivery to site does not cause any unnecessary delays, the Prime Contractor shall submit transmittals, or copies of purchase orders, confirmations from the Sub-Contractor or the Supplier, along with delivery dates to the Architect for his records. This information shall all be submitted at same time, along with a weekly bar graph progress schedule, as prepared by the Prime Contractor. All schedules, purchase orders, etc., shall be submitted and approved by the Architect before any contract work begins.
- D. For purposes of determining the date that contract may be awarded and for ordering materials, and submittal of shop drawings, the date of **March 24, 2026** shall be used.
- E. Physical Work shall begin as soon as weather permits starting **06-15-2026** so that the completion date is achieved. On site storage of materials before this date will only be allowed in a locked trailer at Contractor's expense and with Owner's advanced approval.
- F. All work on this project shall be "**Substantially Completed**" on or before **08-14-2026, at 5:00 P.M.**, or sooner as stated in the bid proposal by the bidder. See this Division regarding Liquidated Damages. All work, including punch lists, paper work, etc., as described for receiving final payment and termed "Final Completion" shall occur within thirty (30) consecutive days after the "Substantial Completion" date. (See Liquidated Damages Section for damages should dates not be met.)
- G. The above dates/schedules are based on current delivery of equipment, estimated man-hours, and anticipated weather conditions for the scope of work. Contractors shall verify availability of all materials during the bidding process and list on the bid proposal the manufacturers of equipment that will not conform to this schedule. Should the equipment manufacturers as specified, not fit the anticipated schedule, list other equal equipment in area provided on bid proposal for substitutions, along with any cost changes for the Owner's consideration

1.11 HAZARDOUS MATERIAL:

- A. If any Contractor during the course of construction, or work, observes the existence of asbestos, lead base paint, P.C.B., or other hazardous materials in the structure or building, or in area of work, the Contractor shall promptly notify the Owner. The Owner shall consult with their environmental consultant regarding removal or encapsulation of the questioned material. The Contractor shall not perform any work pertinent to the hazardous material prior to receipt of special instructions from the Owner. Any work involved with hazardous material removal, handling, etc., shall NOT be part of this Contract or any Field Orders relating to this Contract.
- B. On this particular job and in the area of work, or related area that may be affected due to this work, certain hazardous materials may exist and if known will be properly identified or made known to the Contractor by the Owner. It is the Contractor's responsibility to exercise care in performing all operations of this work to not disturb or affect these materials, either directly, or in-directly (such as water damage, materials dropped, etc.). If an incident should occur, the Contractor shall immediately notify the Owner and his insurance company and safeguard the area. The Owner will make an inspection and advise of all procedures to be implemented. It is the Owner's responsibilities to contact their hazardous material consultant and perform all work to test, remedy and enclose the situation, all at the Contractor's expense. The cost will be deducted from the contract amount, or the Contractor's insurance company will reimburse the Owner directly.

- C. The Architect shall have no responsibility for the discovery, presence, handling, removal, or disposal of, or exposure of persons to asbestos and hazardous materials in any form for the project.
- D. The Contractor shall inform himself of the presence of asbestos/hazardous materials which may be present in the buildings by reviewing the Owner's copy of the A.H.E.R.A. Management Act (Asbestos Hazards Emergency Response Act), which is available in each building, or by contacting the Owner.
- E. The Contractor shall be responsible to inform all workers of all known hazardous materials present at the job site prior to starting any work and instruct each worker on the proper safeguards required, so as not to disrupt any encapsulated or contained hazardous materials.

1.12 SALVAGEABLE ITEMS:

- A. All existing items called for to be removed, or are abandoned, or are in the way of this new work, shall be completely removed and disposed of offsite at a licensed disposal facility by this Contractor unless noted differently.
- B. See related Divisions - 024100 - Demolition and Patching, Mechanical and Electrical Divisions.

1.13 LIQUIDATED DAMAGES & COMPLETION OF WORK:

- A. It is hereby understood and mutually agreed, between the Contractor and the Owner that the date of completion, as specified in the Proposal, is an essential condition of this Contract, and that the time for the completion of the work described herein is a reasonable time for the completion of the same, taking into consideration the average climatic range and prevailing industrial conditions.
- B. If the Contractor shall fail, neglect or refuse to **SUBSTANTIALLY COMPLETE** the work within the time herein specified, or within any proper extension thereof granted by the Owner, the Contractor does hereby agree, as a part of the consideration for awarding this contract, to pay to the Owner the amount specified herein as Class A liquidated damages for each and every calendar day that the Contractor shall be in default after the time stipulated for SUBSTANTIAL COMPLETION of the work. The amount of Class A liquidated damages shall be deducted from the estimated amounts coming due and payable to the Contractor at the rate of **\$1,000** per day, after the date as specified in the special conditions for SUBSTANTIAL COMPLETION.
- C. If the Contractor shall neglect, fail, or refuse to obtain **FINAL COMPLETION** of the contract and final acceptance of the project by the Owner within the time herein specified, or with any proper extension thereof granted by the Owner, then the Contractor does hereby agree, a part of the consideration for awarding this contract, to pay to the Owner the amount specified in the proposal as Class B liquidated damages for each and every calendar day that the Contractor shall be in default after the time stipulated for FINAL COMPLETION and acceptance of the project by the Owner. The amount of Class B liquidated damages shall be deducted from the estimated amounts coming due and payable to the Contractor at the rate of **\$100** per day, after the date as stated in the special conditions for FINAL COMPLETION and acceptance of the project by the Owner.
- D. In the case where the contract includes work at several sites/buildings, the Class A and Class B liquidated damages noted above will apply to each site/building not completed.
- E. The Contractor shall not be charged with liquidated damages or any excess cost when the Owner determines that the Contractor is without fault due to unforeseeable cause beyond the control and without the fault or negligence of the Contractor, including but not restricted to acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and severe weather.
- F. Request for the extension of time for completion beyond the completion date noted in the Invitation to Bid may be requested in writing of the Owner by the Contractor. Such request to be considered must show reasons beyond the control of the Contractor. All requests shall be submitted within five (5) days of when problem becomes known to the Contractor.

1.14 TEMPORARY FACILITIES:

- A. Enclosures - Contractor is responsible for any damage to all materials, stored or built into this work under this contract, due to elements of the weather, vandalism, theft, fire, etc. No open areas of work shall be left open during non-working hours or inclement weather. Contractor is responsible for all damages caused due to this contract, to all materials, whether existing or incorporated into this work.
- B. Storage - Each Contractor shall erect a materials storage shed, properly covered, locked, etc., as required. Contractor is responsible for stored materials. Stolen, damaged or destroyed materials shall be replaced at the Contractor's expense. No inside of building storage of materials is allowed before the date noted herein as start of physical work. No inside storage is allowed after construction starts unless it is in the area of work governed by this contract and is under the Contractor's full control and contract limits.
- C. Field Office - None Required
- D. Toilet Facilities - Workmen will be allowed to use existing facilities. Contractor shall be responsible for maintaining and keeping areas clean.
- E. Miscellaneous - Contractor shall provide all temporary drainage, drains, sumps, walkways, railings, etc., as required for proper execution of work and as required to meet all codes and ordinances.
- F. Debris Removal - All debris resulting from this work shall be cleaned up at end of each day's work and hauled away from job upon completion to a licensed disposal site. Prime Contractor shall provide a dumpster as required for use by all Sub-Contractors and pay for all usage/dump charges.
- G. Removal - Temporary facilities shall be removed when no longer required, or at completion and site restored to original condition.
- H. Exits - Provide temporary ladders, railings, etc., as required for emergency use during construction. Proper exiting of building shall be maintained at all times.
- I. Temporary Heat - Contractor shall provide and maintain all temporary heating and ventilating units during construction as required to properly execute this contract. All fuels used shall be paid for by the Contractor. (No electric units)
- J. Barricades - Provide all necessary barricades, fencing, flagmen, etc., to properly control and assure the safety of workers and the public during this work.
- K. Water - The Prime Contractor shall make suitable connections as required to perform the work. Water to be available at site as provided by the Owner.
- L. Electrical - The Contractor shall make suitable connections as required to perform the work. Electricity will be available on the site as furnished and paid for by the Owner. See Electrical Division for other requirements.
- M. Telephones - Contractor can use on-site pay telephones if available. Contractor is not to use Owner's general telephones.
- N. Fencing - Prime Contractor is to secure the contract limits of this work with snow type fencing or better as needed to secure the construction site off limits to unauthorized people. Safety to staff, students and public is of utmost importance. All ladders, scaffolding, doors, windows, entries, and other attractive/inviting items, shall be secured during non-working hours.
- O. Temporary Fire Barriers - In student occupied buildings, temporary fire rated doors/barriers are to be installed when the students are scheduled to occupy the building and construction is not complete.
- P. Road Maintenance - Contractor shall keep the Owner's roads free of construction spillages and debris at all times. Repair damage caused to these roads by contract-related construction vehicles by replacing damaged pavement and curbing to match existing construction.

Construct and maintain temporary earth ramps for access and egress of heavy construction and delivery vehicles to below grade (excavated) areas of the construction site.

- Q. Parking - Contractor may use designated areas of Owner's parking facilities for passenger vehicles only. Heavy construction equipment will not be permitted on Owner's parking facilities. Maintain and repair any damage caused by use of Owner's parking facilities. Maintain parking area for construction vehicles as designated by the Owner.

1.15 OWNER'S WORK & SCHEDULES:

- A. Owner shall be responsible for removing his equipment and materials from the contract area in sufficient time before the Contractor's work is to begin.
- B. Contractor shall assume that the site and building will be occupied by staff/students during the time of construction. Precautions concerning the safety of occupants shall be exercised at all times.
- C. The Owner reserves the right to award contracts for the work on the same project, or perform work with own personnel. Complete cooperation shall exist between all parties.
- D. Unavoidable shutdowns for purposes of extension of existing utilities (water, electric, etc.), or installation of temporary or permanent work shall be scheduled 48 hours in advance and at the convenience of the Owner during off-use hours.
- E. The Owner reserves the right to make emergency repairs, as required to keep equipment in operation without voiding the Contractor's guarantee bond, nor relieving the Contractor of his responsibilities during the bonding period.
- F. Since students and staff will be occupying the site and building, specific areas for Contractor parking, storage, building access, etc., must be coordinated with Owner. Contractor shall install snow type fences to secure these and construction areas.
- G. Hours of work by this Contractor/Sub-Contractor(s) shall occur between 7:30 A.M. to 4:00 P.M., Monday through Friday. The Owner will be responsible to have the building and site open and closed at times so noted.
- H. Should the Contractor desire times other than those listed above for interior work, the Contractor shall submit a written request to the Owner for consideration and approval forty-eight (48) hours in advance, in order to change the scheduling of their custodial staff and the opening/closing of the building(s)/sites(s). Should this special request be granted by the Owner, the Contractor shall accept and pay the additional costs incurred by the Owner at the rate of \$60 per opening and \$60 per closing of the building/site. This cost will be treated as a Change Order and deducted from the contract cost.

1.16 MISCELLANEOUS COSTS:

- A. The Prime Contractor shall secure and pay for the building permit from the Governing Building Authority, based on the work of all Contractors, along with all costs for inspections, plan review fees, approvals, etc. Sub-contractors shall secure same related permits as required by code. Upon completion, submit all occupancy permits, approvals, etc. It is the Prime Contractor's responsibility to pick up all costs and coordinate the Sub-permits, should the Sub-Contractors under his control fail to do so. All permits, including electrical/mechanical, shall be secured from the State of Michigan. Contact the Michigan Department of Licensing and Regulatory Affairs, Bureau of Construction Codes and Fire Safety, Plan Review Division, P.O. Box 30255, Lansing, MI 48909 (517-241-9328).
- B. The Prime Contractor shall retain the services of an Approved Third-Party Agency to perform all Special Inspections and Testing as required by the Governing Building Code, Governing Building Authority, or as called out in the construction documents. Notify Owner / Architect, immediately, of any failed tests or inspections and provide Owner with all written reports and test results at project completion. See "Special Inspections" in the Governing Building Code for requirements.
- C. Contractor, Sub-Contractor and Supplier shall include in his bid and contract price any Michigan sales and use taxes, currently imposed by legislative enactment.

- D. Electric - the Electrical Contractor shall be responsible and include all power company's back-charge and utility company's work in the bid for all secondary and primary wiring, poles, transformers, meter, meter socket, etc. For either temporary or final service the Prime Contractor shall be responsible for all usage bills, until acceptance by the Owner, or substantial completion.
- E. Electrical Contractor to be responsible for labor and materials for final hook-up of all electrical equipment as supplied under Electrical Division, Mechanical Division, or Equipment Division as furnished by Prime Contractor, unless noted otherwise in specific Divisions, such as overhead door operators. Included are kitchen appliances, lights, fans, motors, etc.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION



* SAMPLE *

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

DATE

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER <u>Agent</u> : Name Address Phone Number Contact Person	CONTACT NAME: PHONE (A/C, No, Ext): FAX (A/C, No): E-MAIL ADDRESS:	
	INSURER(S) AFFORDING COVERAGE INSURER A: <u>List Company for each coverage</u> INSURER B: INSURER C: INSURER D: INSURER E: INSURER F:	
INSURED <u>Contractor</u> : Name Address Phone Number Contact Person	NAIC #	

COVERAGES

CERTIFICATE NUMBER:

REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL SUBR INSR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
	GENERAL LIABILITY ☒ COMMERCIAL GENERAL LIABILITY ☐ CLAIMS-MADE ☒ OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: ☐ POLICY ☐ PRO-JECT ☐ LOC		List #	List Dates		EACH OCCURRENCE \$ 1,000,000 DAMAGE TO RENTED PREMISES (Ea occurrence) \$ MED EXP (Any one person) \$ 5,000 PERSONAL & ADV INJURY \$ 1,000,000 GENERAL AGGREGATE \$ 2,000,000 PRODUCTS - COMP/OP AGG \$ 2,000,000
	AUTOMOBILE LIABILITY ☒ ANY AUTO ALL OWNED AUTOS HIRED AUTOS ☐ SCHEDULED AUTOS NON-OWNED AUTOS		List #			COMBINED SINGLE LIMIT (Ea accident) \$ 1,000,000 BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$
	UMBRELLA LIAB EXCESS LIAB OCCUR CLAIMS-MADE DED RETENTION \$					EACH OCCURRENCE \$ AGGREGATE \$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	Y/N	List #			WC STATUTORY LIMITS OTH-ER E.L. EACH ACCIDENT \$ E.L. DISEASE - EA EMPLOYEE \$ E.L. DISEASE - POLICY LIMIT \$
	Installation Floater Business Risk		List #			Site Amt — stored Transit — or install Total

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

Owner + Architect as additional insured with respect to general liability.
 List actual names (add any attachments)

CERTIFICATE HOLDER

CANCELLATION

Owner: Name Mailing Address <u>NOT Job or Architect</u>	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE Signature of Agent

* SAMPLE *

Project Name
Client

**Type on contractor's letterhead
with complete address, phone
numbers, federal and state ID#**

LETTER OF WARRANTY

**Re: List here Owner's name
and project description
as listed on Architect's
Project Manual**

Date:

We hereby warrant that the work, described as _____, which we have completed at the above mentioned project, has been done in strict accordance with the drawings and specifications and that the work installed will fulfill the requirements of those specifications. We agree to repair or replace or cause to be repaired or replace any or all of work which may prove to be defective in workmanship or materials, together with any adjacent work which requires repair or replacement because of our defective work, within a period of _____ year(s) from date of Certificate of Occupancy or date of final payment by the Owner, whichever is later, ordinary wear and tear and unusual abuse or neglect excepted.

If we fail to commence to comply with the above paragraph within 10 days after receipt of written notice from the Owner to do so or fail to pursue such compliance with diligence, we, jointly and severally, do hereby authorize the Owner to proceed to have the defects repaired and made good at our sole expense, and we will honor and pay the costs and charges for it together with interest at the maximum rate permitted by law upon demand. If we fail to fulfill the preceding obligations, and if the Owner brings an action to enforce this warranty, we agree to pay the Owner's reasonable architect's, attorneys and staff fees incurred in connection therewith.

This guarantee does not limit the requirements for liability and responsibility as covered by the State of Michigan Statute of Limitations, or equipment and manufactured items, which have extended warranties.

Signed

Printed Name / Title

**List bonding company, address,
phone number, as well as the
local bonding agent with same
information.**

**SECTION 012300
ALTERNATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Description of Alternates - work that is to be deducted or added to the Base Proposal for various items, including all labor and materials herein described.

1.02 RELATED REQUIREMENTS

- A. See other related Divisions for the scope of work, type of materials, etc., if not specified herein.
- B. Instructions to Bidders: Instructions for preparation of pricing for Alternates.
- C. Proposal Form(s).
- D. The Alternate work herein is bound by the same conditions and requirements in the main sections of these specifications as governs all other trade divisions. Included shall be Index, Advertisement for Bids, Instructions to Bidders, Bid Proposal Form, General and Special Conditions, etc.
- E. Description(s) of Alternates in this section are not meant to be all inclusive, but give a general understanding of the work to be included. Reference the drawings and other sections of specifications for all work included.

1.03 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. The order of the Alternates are not listed in priority. The number of Alternates accepted will be determined by the Owner that serves their best interest.
- C. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.04 SCHEDULE OF ALTERNATES

- A. **ALTERNATE #1** (ADD) Installation of Gas Fired Domestic Water Heaters at Both Hollywood Elementary School and Orchard Center High School
 - 1. State on the Bid Proposal Form the amount to be added to the Base Bid.
 - 2. Work at **Hollywood Elementary School** includes, but is not limited to the following:
 - a. Architectural
 - 1) Include all associated work with enlarging boiler flue curb in base bid to accommodate the added domestic water heater flue in this alternate.
 - b. Mechanical (Alternate HWD-M1)
 - 1) Omission of indirect water heater boiler-side supply and return piping and circulation pump HWD-HWS-1.
 - 2) Installation of natural gas connection to domestic gas-fired water heater, 1-1/4" gas piping as shown on plans, and new gas pressure regulator.
 - c. Electrical (Alternate HWD-E1)
 - 1) Electrical work associated with the gas-fired domestic water heater (HWD-DWH-1) with the details indicated on the design documents.
 - 2) Omission of all electrical work associated with the inline pump (HWD-HWS-1)
 - d. Plumbing (Alternate HWD-P1)
 - 1) Omission of the new indirect domestic water heater HWD-IWH-1 and accessories.
 - 2) Installation of new gas-fired domestic water heater HWD-DWH-1 and accessories.
 - 3. Work at **Orchard Center High School** includes, but is not limited to the following:
 - a. Architectural
 - 1) Include all associated work with enlarging boiler flue curb in base bid to accommodate the added domestic water heater flue in this alternate.

Boiler Replacement & Related Work
at Several Schools
Monroe Public Schools

#26101-#26102
012300 - 2

- b. Mechanical (Alternate OCoc-m1)
 - 1) Omission of the installation of indirect water heater piping and circulation pump OC-oc-hws-3.
 - 2) Omission of the demolition of natural gas piping distribution to existing gas-fired domestic water heater.
 - 3) Installation of natural gas piping connection to domestic gas-fired water heater, including new gas pressure regulator.
- c. Electrical (Alternate OC-Ec-e1)
 - 1) Electrical work associated with the gas-fired domestic water heater (OC-DWoc-dwh-1) with the details indicated on the design documents.
 - 2) Omission of all electrical work associated with the inline pump (OC=HWS-3)
- d. Plumbing (Alternate OC-P1)
 - 1) Omission of the new indirect domestic water heater OC-IWH-1 and accessories.
 - 2) Installation of new gas-fired domestic water heater OC-DWH-1 and accessories.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 012500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.

The proposal shall be based ONLY upon the furnishing of all materials and/or equipment and accessories as specified by manufacturer or trade names throughout the various specification headings. Where the phrase "approved substitute" and/or "approved equal" appears, the Contractor may, if he desires, request approval from the Owner and Architect. The acceptance of such substitutes, which the Architect and Owner believe to be in the Owner's best interests, will be made prior to bid opening. If no such substitutions are accepted at that time, the Contractor shall furnish only those materials and/or equipment specifically named. Contractor shall submit all pertinent data, manufacturer's specifications, picture cuts, etc., as required by the Architect/Owner for proper evaluation.

1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - a. Unavailability.
 - b. Regulatory changes.
2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
 - a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 2. Agrees to provide the same warranty for the substitution as for the specified product.
 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 5. Waives claims for additional costs or time extension that may subsequently become apparent.
 6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
1. Note explicitly any non-compliant characteristics.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
1. No specific form is required. Contractor's Substitution Request documentation must include the following:
 - a. Project Information:

- 1) Official project name and number, and any additional required identifiers established in Contract Documents.
 - 2) Owner's, Architect's, and Contractor's names.
 - b. Substitution Request Information:
 - 1) Indication of whether the substitution is for cause or convenience.
 - 2) Issue date.
 - 3) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
 - 4) Description of Substitution.
 - 5) Reason why the specified item cannot be provided.
 - 6) Differences between proposed substitution and specified item.
 - 7) Description of how proposed substitution affects other parts of work.
 - c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Expected durability.
 - 4) Visual effect.
 - 5) Warranties.
 - 6) Other salient features and requirements.
 - 7) Include, as appropriate or requested, the following types of documentation:
 - (a) Product Data:
 - (b) Samples.
 - (c) Certificates, test, reports or similar qualification data.
 - (d) Drawings, when required to show impact on adjacent construction elements.
 - d. Impact of Substitution:
 - 1) Savings to Owner for accepting substitution.
 - 2) Change to Contract Time due to accepting substitution.
- D. Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
1. Owner will consider requests for substitutions only if submitted at least 10 days prior to the date for receipt of bids.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- B. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
 - b. Other construction by Owner.

- c. Other unanticipated project considerations.
- C. Substitutions will not be considered under one or more of the following circumstances:
 - 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 - 2. Without a separate written request.
 - 3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.
 - 1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

END OF SECTION

**SECTION 013000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal.
- C. Preconstruction meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Daily Construction Reports
- G. Progress photographs.
- H. Submittals for review, information, and project closeout.
- I. Submittals for payment.
- J.
- K. Worker's Qualification Submittals.
- L. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements: General product requirements.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. It is Contractor's responsibility to submit documents in allowable format.
 - 3. Contractor, Subcontractors, Suppliers, Owner, Architect, Architect's consultants, and any others who are part of the Electronic Document Submittal process are to follow this process.
 - 4. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com).
 - 5. Paper document transmittals will not be reviewed.
 - 6. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Cost: Any cost for this submittal process is to be covered by each user.

3.02 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award to review all schedules, purchase orders, and details of the work. This must be done before any physical work begins - estimated time is 2-3 weeks after contract award. Invited to attend are the Prime Contractors, Owner's Representatives and the Architect/Engineer. Also, the Contractor shall have present, his Foreman, or Superintendent who will be in charge of the job and any Sub-Contractors that are deemed major contributions to the work.
- B. Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Designation of personnel representing the parties to Contract.
 - 5. Contractor to have the following information for distribution at this meeting:
 - a. Progress Schedule - Weekly bar graph of the anticipated progress of work.
 - b. List of all Suppliers, Sub-Contractors, with phone numbers and addresses.
 - c. Schedule of Payment Values
 - d. List of all shop drawings to be submitted. Include spec data sheets, color samples, picture cuts, samples, etc. (See Shop Drawing Schedule at end of Instructions to Bidders.)
 - e. Copies of purchase orders and written confirmation from Supplier/Sub-Contractor.
 - f. Permit applications, or copies of permits, or submit a written letter to the Architect with date, inspector's name and phone number from the Governing Building Authority stating that permits will not be required.
 - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
- C. Architect will record minutes and distribute copies within two days after meeting to participants, Contractor, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the work at maximum weekly intervals.
- B. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Architect.
 - 4. Contractor's superintendent.
 - 5. Major subcontractors.
- C. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems that impede, or will impede, planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Review of RFIs log and status of responses.
 - 7. Review of off-site fabrication and delivery schedules.
 - 8. Maintenance of progress schedule.
 - 9. Corrective measures to regain projected schedules.
 - 10. Planned progress during succeeding work period.
 - 11. Maintenance of quality and work standards.
 - 12. Effect of proposed changes on progress schedule and coordination.
 - 13. Other business relating to work.

- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

3.05 DAILY CONSTRUCTION REPORTS

- A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
- B. In addition to transmitting electronically at daily interval to Owner and Architect, submit electronically with pay app at monthly intervals.
 - 1. Field reports may be handwritten, scanned, and sent in .pdf format; or from electronic project management software (i.e. Raken, FieldLens, or others).
- C. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
 - 1. Date.
 - 2. High and low temperatures, and general weather conditions.
 - 3. List of subcontractors at Project site.
 - 4. List of separate contractors at Project site.
 - 5. Approximate count of personnel at Project site.
 - a. Include a breakdown for supervisors, laborers, journeymen, equipment operators, and helpers.
 - 6. Material deliveries.
 - 7. Safety, environmental, or industrial relations incidents.
 - 8. Meetings and significant decisions.
 - 9. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
 - 10. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
 - 11. Testing and/or inspections performed.
 - 12. List of verbal instruction given by Owner and/or Architect.
 - 13. Signature of Contractor's authorized representative.
 - 14. Progress Photographs

3.06 PROGRESS PHOTOGRAPHS

- A. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.
- B. Photography Type: Digital; electronic files.
- C. In addition to periodic, recurring views, take photographs of each of the following events:
 - 1. Completion of site clearing.
 - 2. Excavations in progress.
 - 3. Foundations in progress and upon completion.
 - 4. Structural framing in progress and upon completion.

5. Enclosure of building, upon completion.
6. Final completion, minimum of ten (10) photos.
- D. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
 1. Delivery Medium: Via email.
 2. File Naming: Include project identification, date and time of view, and view identification.
 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
 4. Photo CD(s): Provide 1 copy including all photos cumulative to date and PDF file(s), with files organized in separate folders by submittal date.

3.07 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 1. Prepare a separate RFI for each specific item.
 2. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 016000 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
 3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 2. Owner's, Architect's, and Contractor's names.
 3. Discrete and consecutive RFI number, and descriptive subject/title.
 4. Issue date, and requested reply date.

5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 2. Note dates of when each request is made, and when a response is received.
 3. Highlight items requiring priority or expedited response.
 4. Highlight items for which a timely response has not been received to date.
- H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
 3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
 4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.08 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
1. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 2. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.09 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
1. Product data.
 2. Shop drawings.
 3. Samples for selection.

4. Samples for verification.
- B. All must be submitted and reviewed prior to ordering that particular item and starting any physical work on the job site unless other arrangements are made with the Architect in advance:
- C. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- D. Samples will be reviewed for aesthetic, color, or finish selection.
- E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.
- F. Architect's Action - Architect will acknowledge receipt, review each submittal, and process one of the following ways: No Exception Taken, Reviewed as Noted, Revise / Resubmit, Not Reviewed, Request More Information, or take other appropriate action.

3.10 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 1. Design data.
 2. Certificates.
 3. Test reports.
 4. Inspection reports.
 5. Manufacturer's instructions.
 6. Manufacturer's field reports.
 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.
- C. Architect's Action - Architect will acknowledge receipt, review each submittal, and process one of the following ways: No Exception Taken, Reviewed as Noted, Revise / Resubmit, Not Reviewed, Request More Information, or take other appropriate action.

3.11 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
 1. Project record documents.
 2. Operation and maintenance data.
 3. Warranties.
 4. Bonds.
 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.12 PAY REQUEST SUBMITALS

- A. Contractor shall file electronic (.pdf) applications for monthly payment installments with the Architect in accordance with the requirements of the General Conditions if a 100% Performance/Labor and Material Bond is a part of this contract. Otherwise no payment shall be made until completion of the work.
- B. Submitted with the first application for payment, the Contractor shall file with the Architect, for his approval, a schedule of values for the various parts of the work aggregating the contract sum. Schedule shall be in such form and in sufficient detail to facilitate issuance of certificates of payment. Schedule shall become the basis for payments and shall accompany all remaining applications for payments.

- C. Pay Request Submittals - Must be submitted to the Architect (1) week before it goes to Owner. Owner needs (20) days for processing and issuing check. Note any special dates that request for payments must be received by Owner. Otherwise dates will be established at the pre-construction meeting.
 - 1. AIA Form G-702, signed and notarized.
 - 2. AIA Form G-703, complete with line item breakdowns for General Conditions, Architectural Trades, Mechanical, Electrical, etc.
 - 3. Waiver of Lien from Contractor, each Sub-Contractor, each Major Material Supplier for preceding pay request.
 - 4. Contractors Sworn statement. (See sample Statement at the end of this section. This sample statement is available from architect in electronic format. Any other Sworn statement form shall include, at least, the column information shown on sample.)
 - 5. Labor/Payroll Forms from Contractor and each Sub-Contractor listing each Worker's name, address, social security number, trade classification, rate of pay, hours and week worked. HUD Form WH 347, or Certified Payroll Form is acceptable. Must be signed. This is applicable only if a State Prevailing Wage or Federal Wage Rate Project.
 - 6. Daily Field Reports since previous pay application.
 - 7. Progress Photographs since previous pay application.
- D. Final Pay Request shall include the above items, plus the following items:
 - 1. Final Waivers of Lien from Contractor, all Sub-Contractors, all Major Material Suppliers
 - 2. Contractor's Affidavit of Payment of Debts and Claims, AIA Form G706
 - 3. Consent of Surety Company to Final Payment, AIA Form G707
 - 4. Contractor's written Warranty per 007400 - Supplementary and Special Conditions from the date of Final Payment.
 - 5. All written Warranties per Section 007400 - Supplementary and Special Conditions of Specifications from Manufacturer's Components/Systems, as noted in other Divisions of these Specifications.
 - 6. "As-Built" Drawings, showing any changes from bidding drawings. Including "site survey" verifying all grades, dimensioning locations of all U.G. valves, clean-outs, taps, etc. per requirements listed elsewhere.
 - 7. Final Approval Certificates from the Governing Building Officials on all Construction Permits obtained, and/or required.
 - 8. Copies of all Maintenance Manuals/Procedures from the Manufacturers of all Pre-Manufactured Components/Systems, plus (1) complete set of all Shop Drawings for project.
 - 9. List containing all Sub-Contractors, their Suppliers and related products with names, address, contact person and phone numbers.
- E. Architect's Action - Architect will acknowledge receipt, review each submittal, and process one of the following ways: Process with owner copying contractor, Hold and notify contractor of items needing correction, Reject and notify contractor of reason(s), or take other appropriate action.

3.13 WORKER'S QUALIFICATION SUBMITTALS

- A. Must be submitted electronically within two (2) weeks after receiving notice to proceed. This includes Prime Contractor and all major Sub-Contractors.
 - 1. List with each worker's name, address, social security number, trade classification, years of trade experience and years employed by Contractor. See other Divisions of these specifications that may set ratios of apprentices to journeymen.
 - 2. Conviction Disclosure Form, (copy attached at the end of this Division) and a copy of their driver's license or legal photo I.D. for each worker on the construction site with the name and signature of each worker.
- B. Architect's Action - Architect will acknowledge receipt, review each submittal, and process one of the following ways: Process with owner copying contractor, Hold and notify contractor of

items needing correction, Reject and notify contractor of reason(s), or take other appropriate action.

3.14 SUBMITTAL PROCEDURES

A. General Requirements:

1. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
2. Transmit using approved form.
 - a. Use form generated by Electronic Document Submittal Service software. If Electronic Document Submittal Service is not used for this project, use Contractor's form, subject to prior approval by Architect.
3. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
4. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
5. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
6. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Send submittals in electronic format via email to Architect.
7. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
9. Provide space for Contractor and Architect review stamps.
10. When revised for resubmission, identify all changes made since previous submission.
11. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
12. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
13. Submittals not requested will be recognized, and will be returned "Not Reviewed",

B. Product Data Procedures:

1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Submit concurrently with related shop drawing submittal.
4. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:

1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
2. Do not reproduce Contract Documents to create shop drawings.
3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
4. At a minimum, shop drawings shall:
 - a. Convey the contractor's understanding of the work to be performed meets the design intent and contract documents.

- b. Coordinate material/equipment options (i.e. finish/color selections, power requirements, etc.).
 - c. Include any information needed by other trades for a complete coordination of the work to be provided.
- D. Samples Procedures:
 - 1. Transmit related items together as single package.
 - 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
 - 3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

END OF SECTION

Name of Project _____
 Project Address _____
 Client _____
 Client Address _____
 Arch. Project # _____

Date: _____
 Page 1 of 4

SWORN STATEMENT

STATE OF MICHIGAN) SS:
 COUNTY OF _____)

_____, *[name of person swearing statement]*, being duly sworn, states the following:

_____, *[name of contractor]* is the contractor for an improvement to the following real property in _____ County, Michigan, described as follows: *[Give the legal description of the property.]*

The following is a statement of each subcontractor, supplier and laborer for whom payment of wages or fringe benefits and withholdings is due but unpaid with whom the contractor has contracted for performance under the contract with the owner or lessee, and the amounts due to the persons as of the date of this statement are correctly and fully set forth opposite their names:

Name, Address & Phone No. of Subcontractor, Supplier or Laborer	Type of Improvement Furnished	Total Contract Price	Change Orders	Adjusted Contract Price	Subcontractor Paid to Date	Current Request	Retainage	Balance to Complete
TOTALS:								

[NOTE: It is not necessary to list any materials furnished by the contractor / subcontractor out of his/her own inventory, and which have not been purchased specifically for performing the contract.]

The contractor has not procured materials from, or subcontracted with, any person other than those set forth above, and owes no money for the improvement other than the sums set forth above.

I make this statement as the contractor or as _____ *[capacity]* of the contractor to represent to the owner or lessee of the property and his/her agents that the property is free from claims of construction liens, or the possibility of construction liens, except as specifically set forth in this statement and except for claims of construction liens by laborers that may be provided under Section 109 of the Construction Lien Act, 1980 PA 497, MCL 570.1109.

Name of Project _____
Project Address _____
Client _____
Client Address _____
Arch. Project # _____

Date: _____
Page 2 of 4

SWORN STATEMENT

WARNING TO OWNER OR LESSEE: AN OWNER OR LESSEE OF THE PROPERTY MAY NOT RELY ON THIS SWORN STATEMENT TO AVOID THE CLAIM OF A SUBCONTRACTOR, SUPPLIER OR LABORER WHO HAS PROVIDED A NOTICE OF FURNISHING OR A LABORER WHO MAY PROVIDE A NOTICE OF FURNISHING UNDER SECTION 109 OF THE CONSTRUCTION LIEN ACT, 1980 PA 497, MCL 570.1109 TO THE DESIGNEE OR TO THE OWNER OR LESSEE IF THE DESIGNEE IS NOT NAMED OR HAS DIED.

IF THIS SWORN STATEMENT IS IN REGARD TO A RESIDENTIAL STRUCTURE, ON RECEIPT OF THIS SWORN STATEMENT, THE OWNER OR LESSEE, OR THE OWNER'S OR LESSEE'S DESIGNEE MUST GIVE NOTICE OF ITS RECEIPT, EITHER IN WRITING, OR BY TELEPHONE, OR PERSONALLY, TO EACH SUBCONTRACTOR, SUPPLIER, AND LABORER WHO HAS PROVIDED A NOTICE OF FURNISHING UNDER SECTION 109 OR, IF A NOTICE OF FURNISHING IS EXCUSED UNDER SECTION 108 OR 108A, TO EACH SUBCONTRACTOR, SUPPLIER, AND LABORER NAMED IN THE SWORN STATEMENT. IF A SUBCONTRACTOR, SUPPLIER, OR LABORER WHO HAS PROVIDED A NOTICE OF FURNISHING OR WHO IS NAMED IN THE SWORN STATEMENT MAKES A REQUEST, THE OWNER, LESSEE, OR DESIGNEE SHALL PROVIDE THE REQUESTER A COPY OF THE SWORN STATEMENT WITHIN 10 BUSINESS DAYS AFTER RECEIVING THE REQUEST.

Signature of Deponent

Print Name

WARNING TO DEPONENT: A PERSON WHO GIVES A FALSE SWORN STATEMENT WITH INTENT TO DEFRAUD IS SUBJECT TO CRIMINAL PENALTIES AS PROVIDED IN SECTION 110 OF THE CONSTRUCTION LIEN ACT, 1980 PA 497, MCL 570.1110.

Subscribed and sworn to before me this _____ day of _____, 20____.

Notary Public, _____ County, _____ State
Print Name: _____
My Commission Expires: _____

Name of Project _____
Project Address _____
Client _____
Client Address _____
Arch. Project # _____

Date: _____
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SWORN STATEMENT

570.1110 Sworn statement by contractor or subcontractor; contents; form; notice of receipt; withholding from contractor or subcontractor amount due subcontractors, suppliers, laborers, or lien claimants; direct payments to lien claimants; notice; itemized statement; reliance on sworn statement to avoid claim; failure of contractor or subcontractor to provide sworn statement to owner or lessee prior to recording claim of lien; giving false sworn statement to owner or lessee as crime; total amount; prior convictions; prohibited use.

Sec. 110.

(1) A contractor shall provide a sworn statement to the owner or lessee in each of the following circumstances:

(a) When payment is due to the contractor from the owner or lessee or when the contractor requests payment from the owner or lessee.

(b) When a demand for the sworn statement has been made by or on behalf of the owner or lessee.

(2) A subcontractor shall provide a sworn statement to the owner or lessee when a demand for the sworn statement has been made by or on behalf of the owner or lessee and, if applicable, the owner or lessee has complied with the requirements of subsection (6).

(3) A subcontractor shall provide a sworn statement to the contractor when payment is due to the subcontractor from the contractor or when the subcontractor requests payment from the contractor.

(4) A sworn statement shall list each subcontractor and supplier with whom the person issuing the sworn statement has contracted relative to the improvement to the real property. The sworn statement shall contain a list of laborers with whom the person issuing the sworn statement has contracted relative to the improvement to the real property and for whom payment for wages or fringe benefits and withholdings are due but unpaid and the itemized amount of such wages or fringe benefits and withholdings.

(5) The contractor or subcontractor is not required to list in the sworn statement material furnished by the contractor or subcontractor out of his or her own inventory that was not purchased specifically for performing the contract.

(6) On receipt of a sworn statement regarding an improvement to a residential structure, the owner, lessee, or designee shall give notice of its receipt, either in writing, by telephone, or personally, to each subcontractor, supplier, and laborer who has provided a notice of furnishing under section 109 or, if a notice of furnishing is excused under section 108 or 108a, to each subcontractor, supplier, and laborer named in the sworn statement. If a subcontractor, supplier, or laborer entitled to notice under this subsection requests a copy of the sworn statement, the owner, lessee, or designee shall provide the requester a copy within 10 business days after receiving the request.

(7) After the contractor or subcontractor provides the sworn statement, the owner or lessee may withhold or, upon written demand from the contractor, shall withhold from the amount due or to become due to the contractor or to the subcontractor for work already performed an amount sufficient to pay all sums due to subcontractors, suppliers, or laborers, as shown by the sworn statement, or due to lien claimants who have provided a notice of furnishing under section 109. From the amount withheld, the owner or lessee may directly pay subcontractors, suppliers, or laborers the amount they are due as shown by the sworn statement. If the contract provides for payments by the owner to the general contractor in the normal course of construction, but the owner elects to pay lien claimants directly under this section, the first time the owner elects to make payment directly to a lien claimant, he or she shall provide at least 5 business days' notice to the general contractor of the intention to make direct payment. Subsequent direct disbursements to lien claimants need not be preceded by the 5-day notice provided in this section unless the owner first returns to the practice of paying all sums to the general contractor. As between the owner or lessee and the contractor or subcontractor, all payments made under this subsection are considered the same as if paid directly to the contractor or subcontractor. If an amount is withheld under this subsection from the contractor or subcontractor, the owner or lessee, upon request, shall prepare and provide to the contractor or subcontractor an itemized statement of the sums withheld. If an amount is paid directly to a lien claimant under this section, the owner or lessee shall, if requested by the contractor or subcontractor, provide to the contractor or subcontractor an itemized statement of the sums paid.

(8) An owner, lessee, designee, mortgagee, or contractor may rely on a sworn statement prepared by a party other than himself or herself to avoid the claim of a subcontractor, supplier, or laborer unless the subcontractor, supplier, or laborer has provided a notice of furnishing as required under section 109 or unless the notice of furnishing is excused under section 108 or 108a.

(9) If a contractor fails to provide a sworn statement to the owner or lessee before recording the contractor's claim of lien, the contractor's construction lien is not invalid. However, the contractor is not entitled to any payment, and a complaint, cross-claim, or counterclaim may not be filed to enforce the construction lien, until the sworn statement has been provided.

Name of Project _____
Project Address _____
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SWORN STATEMENT

(10) If a subcontractor fails to provide a sworn statement under subsection (2) to the owner or lessee before recording the subcontractor's claim of lien, the subcontractor's construction lien is valid. However, a complaint, cross-claim, or counterclaim may not be filed to enforce the construction lien until the sworn statement has been provided.

(11) A contractor or subcontractor who desires to draw money and gives or causes to be given to any owner or lessee a sworn statement required by this section that is false, with intent to defraud, is guilty of a crime as follows:

a) If the statement involved is for less than \$200.00, the contractor or subcontractor is guilty of a misdemeanor punishable by imprisonment for not more than 93 days or a fine of not more than \$500.00 or 3 times the statement amount, whichever is greater, or both imprisonment and a fine.

(b) If any of the following apply, the contractor or subcontractor is guilty of a misdemeanor punishable by imprisonment for not more than 1 year or a fine of not more than \$2,000.00 or 3 times the statement amount, whichever is greater, or both imprisonment and a fine:

(i) The statement involved is for \$200.00 or more but less than \$1,000.00.

(ii) The statement involved is for less than \$200.00 and the contractor or subcontractor has 1 or more prior convictions for committing or attempting to commit an offense under this act.

(c) If any of the following apply, the contractor or subcontractor is guilty of a felony punishable by imprisonment for not more than 5 years or a fine of not more than \$10,000.00 or 3 times the statement amount, whichever is greater, or both imprisonment and a fine:

(i) The statement involved is for \$1,000.00 or more but less than \$20,000.00.

(ii) The statement involved is for more than \$200.00 but less than \$1,000.00 and the contractor or subcontractor has 1 or more prior convictions for violating or attempting to violate this act. For purposes of this subparagraph, however, a prior conviction does not include a conviction for a violation or attempted violation described in subdivision (a) or (b)(ii).

(d) If any of the following apply, the contractor or subcontractor is guilty of a felony punishable by imprisonment for not more than 10 years or a fine of not more than \$15,000.00 or 3 times the statement amount, whichever is greater, or both imprisonment and a fine:

(i) The statement involved is for \$20,000.00 or more.

(ii) The statement involved is for \$1,000.00 or more but less than \$20,000.00 and the contractor or subcontractor has 2 or more prior convictions for committing or attempting to commit an offense under this act. For purposes of this subparagraph, however, a prior conviction does not include a conviction for a violation or attempted violation described in subdivision (a) or (b)(ii).

(12) For purposes of subsection (11), statements involved in separate incidents pursuant to a scheme or course of conduct within any 12-month period may be aggregated to determine the total amount involved in the statements.

(13) If the prosecuting attorney intends to seek an enhanced sentence for a violation under this section based upon the defendant having 1 or more prior convictions, the prosecuting attorney shall include in the complaint and information a statement listing the prior conviction or convictions. The existence of the defendant's prior conviction or convictions shall be determined by the court, without a jury, at sentencing or at a separate hearing for that purpose before sentencing. The existence of a prior conviction may be established by any evidence relevant for that purpose, including, but not limited to, 1 or more of the following:

(a) A copy of the judgment of conviction.

(b) A transcript of a prior trial, plea-taking, or sentencing.

(c) Information contained in a presentence report.

(d) The defendant's statement.

(14) If the sentence for a conviction under this section is enhanced by 1 or more convictions, those prior convictions shall not be used to further enhance the sentence for the conviction pursuant to section 10, 11, or 12 of chapter IX of the code of criminal procedure, 1927 PA 175, MCL 769.10, 769.11, and 769.12.

DATE COPIED TO ARCHITECT _____

PROJECT: _____ **ARCHITECT'S PROJECT NUMBER** _____

PERCENT COMPLETE: _____ **CONFORMANCE WITH SCHEDULE (+,-)** _____

[illegible]

REPORTED BY: _____ PAGE _____ OF _____ PAGES

**SECTION 015000
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary Controls: Barriers and enclosures.
- B. Waste removal facilities and services.

1.02 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.03 INTERIOR ENCLOSURES

- A. Protect all areas adjacent to construction AND common points of travel to and from construction areas. Protection in these areas to include air quality, walk surfaces, equipment, furnishings, building occupants, etc. from dust / debris, excessive noise, wear, or damage of any kind. Prior to any physical work, the contractor must have a written plan for protection approved by the architect.
- B. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- C. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.04 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 016000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Re-use of existing products.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations.
- E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

1.03 SUBMITTALS

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within 15 days after date of Agreement.
 - 2. For products specified only by reference standards, list applicable reference standards.
- B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- D. Specific Products to be Reused: The reuse of certain materials and equipment already existing on the project site is required.
 - 1. See Section 011000 for list of items required to be salvaged for reuse and relocation.
 - 2. If reuse of other existing materials or equipment is desired, submit substitution request.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Containing lead, cadmium, or asbestos.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Furnish min. 5% replacement stock materials for all non-painted ceiling, flooring, and wall coverings installed as part of this work.
- C. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 012500 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.
 - 1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.
- E. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- F. For exterior storage of fabricated products, place on sloped supports above ground.
- G. Provide off-site storage and protection when site does not permit on-site storage or protection.

- H. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- I. Comply with manufacturer's warranty conditions, if any.
- J. Do not store products directly on the ground.
- K. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- L. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- M. Prevent contact with material that may cause corrosion, discoloration, or staining.
- N. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- O. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

**SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Storage of Materials
- H. Starting of systems and equipment.
- I. Demonstration and instruction of Owner personnel.
- J. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 RELATED REQUIREMENTS

- A. Section 015000 - Temporary Facilities and Controls: Temporary exterior enclosures.
- B. Section 015000 - Temporary Facilities and Controls: Temporary interior partitions.
- C. Section 078400 - Firestopping.
- D. Individual Product Specification Sections:
 - 1. Advance notification to other sections of openings required in work of those sections.
 - 2. Limitations on cutting structural members.

1.03 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2019.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences. Include design drawings and calculations for bracing and shoring.
 - 2. Identify demolition firm and submit qualifications.
 - 3. Include a summary of safety procedures.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.05 QUALIFICATIONS

- A. For demolition work, employ a firm specializing in the type of work required.
 - 1. Minimum of 5 years of documented experience.
- B. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.06 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Perform dewatering activities, as required, for the duration of the project.
- E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- F. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

1.07 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
 - 2. Relocate items indicated on drawings.
 - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 - 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 - 4. Verify that abandoned services serve only abandoned facilities.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub

and tag with identification; patch holes left by removal using materials specified for new construction.

- F. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
 - 1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
 - 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 - 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- J. Clean existing systems and equipment.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

- A. The Prime Contractor shall be responsible for coordinating all cutting and patching of built work that needs to be modified for missed items, errors, defects, etc., as caused by his own Employees or Sub-contractors. He shall coordinate with related trades and Sub-Contractors and work out all details and scheduling. The Prime Contractor shall coordinate with the responsible party for the problem and extra work and shall resolve all costs to correct, without additional charge to the Owner.
- B. Whenever possible, execute the work by methods that avoid cutting or patching.
- C. See Alterations article above for additional requirements.
- D. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.
- E. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- F. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- G. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

- H. Restore work with new products in accordance with requirements of Contract Documents.
- I. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- J. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.
- K. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

- A. On a daily basis, all rubbish and debris shall be cleaned up and placed in a dumpster on the job site to be removed/replaced as needed to a licensed disposal site. The building site shall be kept neat and organized, so that work and safety of all trades is not affected. Submit written documentation, manifests, logs, etc. of all debris removal at completion of job.
- B. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- C. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- D. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- E. Collect and remove waste materials, debris, and trash/rubbish from site daily and dispose off-site; do not burn or bury.
- F. It shall be the Prime Contractor's responsibility to clean-up and co-ordinate work areas so that each trade can perform their work safely and efficiently or direct and enforce that each Sub-Contractor conforms to these same requirements.
- G. Should the Contractor fail to clean-up debris caused from his operations and properly store and remove from site on a daily basis, the Owner in a safety/emergency situation without notice to the Contractor may elect to clean up debris with their own work force. At other times the Owner will give Contractor advance notice. All costs incurred by the Owner due to Contractor's neglect will be documented and deducted against the final contract amount due to the Contractor.

3.09 STORAGE OF MATERIALS

- A. Materials used as part of this work shall be neatly stored and properly protected in an organized manner, so they do not interfere with the work, safety of all trades and hazard or damage to the site/building. Vandalism arising from improperly stored materials to the Owner's site/building shall be borne by the Contractor.

3.10 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.11 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and Owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.12 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.13 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.14 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.

- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.
- I. If this contract involves construction of a new building, remodeling, or additions the scope of clean up shall be more than the normal removal of rubbish and leaving the work areas clean. The Contractor shall clean all new work, wash floors, vacuum carpet, wash glass, remove all stickers, replace broken glass, remove stains, spots, marks, dust and dirt from all decorated work and finishes, including all existing areas affected by this operation, including tenants furnishings, contents and personal belongings. All damage to lawns, walks, pavement, vehicles or other operations in performing this work shall be repaired or replaced to an equal, or better condition than before the damage occurred. The project shall be ready for Owner's occupancy and use when completed.

3.15 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION

SECTION 024100 DEMOLITION AND PATCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.
- B. Removal of interior concrete slab for sanitary work

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- B. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.03 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2019.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Site Plan: Indicate:
 - 1. Areas for temporary construction and field offices.
 - 2. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
 - 1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
 - 2. Demolition firm qualifications.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

- A. All demolition workmanship shall be of first quality, performed by skilled workers with items carefully removed to not damage existing work that remains or to be built upon/modified by other trades. The Demolition Contractor or workers shall be knowledgeable of the systems and materials they are removing. Coordinate all demolition work with the Sub-Contractors that will be required to repair, extend, modify, alter, etc., the item or items involved. Where possible, the actual trade performing the re-construction shall perform the demolition.

PART 3 EXECUTION

2.01 DEMOLITION

- A. Work included consists of, but is not limited to the following:
 - 1. Selective removal of roofing, decking, structure, ceilings, walls, slabs, floor finishes, joints, masonry, misc. equipment, doors/frames, etc., as detailed or required for new work and/or maintenance repairs.
 - 2. See related mechanical, electrical, and plumbing specifications for other items.
 - 3. Where necessary or specified, saw cut, core drill, etc., certain areas to prevent unnecessary destruction of the existing work, which may otherwise require extra re-building to return to original or acceptable condition as existed before starting new work.
 - 4. Miscellaneous finishes as required for new work.
 - 5. All other work as indicated on the drawings.
- B. Remove other items indicated, for salvage, relocation, and recycling.

2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
 - 9. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
 - 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Do not begin removal until built elements to be salvaged or relocated have been removed.
- D. Protect existing structures and other elements to remain in place and not removed.
 - 1. Design, install, and maintain formwork, falsework, shoring, reshoring, bracing and other temporary systems required to support construction loads and to maintain stability during construction. Engage the services of professional engineer licensed in state of project to design such temporary systems.
 - 2. When it is necessary to cut openings in existing concrete members, slabs, or masonry, locate existing prestressing tendons, reinforcing bars, and embedments, by x-ray, electromagnetic, or ultrasonic testing or by chipping. Do not cut or damage prestressing tendons and minimize cutting of other reinforcing bars and embedments. Notify Architect of existing reinforcing bars and embedments which will be cut by openings.
 - 3. Prevent movement or settlement of adjacent structures.
 - 4. Stop work immediately if adjacent structures appear to be in danger.
 - 5. It is the contractor's responsibility to exercise proper care to protect all surroundings (air quality, furnishings, building, occupants, etc.) during all phases of construction. Certain areas with high replacement costs, containing occupants, still under warranty, and/or easily damaged should have added protection features. An example would be "flat" roofs and gymnasium floors and any walking surface to remain being covered using protective boards to prevent puncturing, denting, surface scratching, and wear. Prior to any physical work, the contractor must have a written plan for protection approved by the architect.
- E. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- F. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- G. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Dismantle existing construction and separate materials.
 - 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

2.03 SALVAGEABLE MATERIALS

- A. Where noted in Special Conditions, or herein, or other related Divisions or in the drawings, including mechanical and electrical, carefully remove certain items and store on job site in mutually agreed upon areas for Owner to pick-up and remove.
- B. Any salvageable items as requested to become the property of the Owner, and the Contractor feels the item will be destroyed in the removal process, or is not cost effective to carefully removed, shall be stated as such in the Bid Proposal. Also any item or items scheduled to be turned over to the Owner, which the Contractor feels has substantial salvageable value and wishes to retain, he may elect to submit a credit for Owner's consideration on the Bid Proposal.
- C. Contractor shall verify and coordinate salvageable material selection with the Owner prior to removal from the job site.
- D. Salvageable items to turn over to the owner include but are not limited to:
 - 1. Doors and Door hardware
 - 2. Other items as noted on the plans.
- E. Special Note - Wherever contractor removes ceiling tile, it shall be saved until the end of job for blending into the existing ceilings as needed at other areas / work throughout the building. At the end of project, the owner has the option of keeping the salvaged tile or having contractor haul off at his expense.

2.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
 - 1. Verify construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from areas that remain occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.
- D. Remove existing work as indicated and required to accomplish new work.
 - 1. Remove items indicated on drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure. Provide shoring and bracing as required.
 - 2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch to match new work.

2.05 PATCHING

- A. Where certain items are called for to be replaced, removed, repaired, altered, etc., and the work involves the removal/destruction of adjacent or related existing items, those damaged items shall be patched, repaired, replaced to their original or better condition as existed before the work is started. A typical example would be regarding new door/frame replacement in same wall. Included as part of the work is any wall damage caused by the removal of door/frame and the installation of the new - including finishes.
- B. Where not shown on drawings, all patching, painting, etc. shall be done with similar materials or an approved substitute to the surrounding areas or as specified in other related Divisions and as recommended by manufacturer. If the Contractor is in question, consult the Architect prior to removal or replacement. All materials shall be carefully removed to avoid damage to other work not scheduled for demolition or for turning over to the Owner.
- C. All patching work shall be uniform in appearance, flush, same texture, etc. with the adjacent existing work. In certain instances, to achieve this, additional adjacent work may be necessary to remove and replace. Typical examples would be:
- D. Any patch painting shall be done in geometric configurations, stopping at logical break points, such as inside or outside corners, at change of materials, or as directed by Owner/Architect.
- E. Neatly saw cut existing walls for installation of new shower panel frames. Grout all surrounding masonry solid in preparation of frame installation.
- F. Where existing tile ceilings are removed during Owners asbestos abatement, and the work will be exposed, patching may be done with matching plaster of 5/8" drywall properly anchored, taped and spackled.
- G. Where existing walls are removed and/or finishes are removed, the substrate material shall be cleaned, ground down, filled, leveled smooth, etc. and made ready for new finishes and/or materials as specified. Flatness tolerance shall be Class 'A' (1/8" deviation in 10'). Leveling shall be done with materials as manufactured by Ardex, Sika, Thoro, or equal.

2.06 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

**SECTION 030100
MAINTENANCE OF CONCRETE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of existing concrete surfaces as required for new work.
- B. Resurfacing of existing concrete surfaces having spalled areas and other damage.
- C. Leveling of existing concrete surfaces to meet flatness tolerances.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 033000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.03 REFERENCE STANDARDS

- A. ASTM F2170, Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- B. ASTM F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
- C. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.

1.05 QUALITY ASSURANCE

- A. Cleaner Qualifications: Company specializing in, and with minimum of 3 years of experience in, the type of cleaning specified.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum of 3 years of documented experience.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS

- A. Degreaser:
 - 1. Manufacturers:
 - a. Euclid Chemical Company; Euco Clean and Strip: www.euclidchemical.com/#sle.
 - b. SpecChem, LLC; Orange Peel-Citrus Cleaner: www.specchemllc.com/#sle.
 - c. W. R. Meadows, Inc; 2 Step Ultrite Cleaner: www.wrmeadows.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- B. Detergent: Non-ionic detergent.

2.02 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

- A. Manufacturers:
 - 1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
 - 2. Euclid Chemical Company: www.euclidchemical.com/#sle.
 - 3. W. R. Meadows, Inc: www.wrmeadows.com/#sle.
- B. Cementitious Repair Mortar, Trowel Grade: One- or two-component, factory-mixed, polymer-modified cementitious mortar.
 - 1. Manufacturers:

- a. ARDEX Engineered Cements; ARDEX Feather Finish:
www.ardexamericas.com/#sle.
- b. Euclid Chemical Company; EucoRepair V100: www.euclidchemical.com/#sle.
- c. W. R. Meadows, Inc; Meadow-Patch T1, Meadow-Patch T2, Meadow-Patch 5, or Meadow-Patch 20: www.wrmeadows.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means acceptance of substrate.

3.02 PREPARATION

- A. Prepare concrete surfaces to be repaired according to ICRI 310.2R.

3.03 CLEANING EXISTING CONCRETE

- A. Provide enclosures, barricades, and other temporary construction as required to protect adjacent work from damage.
- B. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
 1. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage.
 2. Clean out cracks and voids using same methods.
- C. The following are acceptable cleaning methods, in order from gentlest to less gentle:
 1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, brushes with natural or synthetic bristles.
 2. Increasing the water washing pressure to maximum of 400 psi.
 3. Adding detergent to washing water; with final water rinse to remove residual detergent.
 4. Steam-generated low-pressure hot-water washing.
 5. Abrasive blasting: Use only abrasive media that have been proven not to damage concrete by testing on mock-up.

3.04 CONCRETE SURFACE REPAIR USING CEMENTITIOUS MATERIALS

- A. Clean concrete surfaces, cracks, and joints of dirt, laitance, corrosion, and other contamination using method(s) specified above and allow to dry.
- B. Apply coating of bonding agent to entire concrete surface to be repaired.
- C. Fill voids with cementitious mortar flush with surface.
- D. Apply repair mortar by steel trowel to a minimum thickness of 1/4 inch (6 mm) over entire surface, terminating at a vertical change in plane on all sides.
- E. Trowel finish to match adjacent concrete surfaces.

END OF SECTION

**SECTION 031000
CONCRETE FORMING AND ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 032000 - Concrete Reinforcing.
- D. Section 033000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 301 - Specifications for Structural Concrete; 2016.
- C. ACI 347R - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

2.02 WOOD FORM MATERIALS

- A. Form Materials: Lumber used in forms for exposed surfaces shall be dressed to a uniform width and thickness and shall be free from loose knots or other defects. Joints in forms shall be horizontal or vertical. Undressed lumber may be used for rough work or unexposed work.

2.03 FORMWORK ACCESSORIES

- A. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
 - 1. Composition: Colorless, reactive, water-based or solvent-based compound.
 - 2. Do not use materials containing diesel oil or petroleum-based compounds.
 - 3. VOC Content: In compliance with applicable local, State, and federal regulations.
 - 4. Products:
 - a. SpecChem, LLC; SpecStrip: www.specchemllc.com/#sle.
 - b. W. R. Meadows, Inc; Duogard: www.wrmeadows.com/#sle.
- B. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- C. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 051200.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. If the nature of the soil will permit, trenches for wall footings may be cut to accurate sizes and side form omitted where the earth will properly contain the concrete. Conform with requirements/recommendations of ACI 347R for formwork.
- D. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- E. Coordinate this section with other sections of work that require attachment of components to formwork.
- F. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.03 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.04 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

3.05 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.

3.06 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

3.07 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

END OF SECTION

**SECTION 032000
CONCRETE REINFORCING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 031000 - Concrete Forming and Accessories.
- D. Section 033000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete; 2016.
- B. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
- C. ACI SP-66 - ACI Detailing Manual; 2004.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- E. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement; 2019, with Editorial Revision.
- F. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2019.
- G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- H. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars; 2021.
- I. CRSI (DA4) - Manual of Standard Practice; 2009.
- J. CRSI (P1) - Placing Reinforcing Bars, 10th Edition; 2019.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.
 - 1. Maintain one copy of each document on project site.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
 - 1. Unfinished.
 - 2. Where required, Epoxy coated in accordance with ASTM A775/A775M.
- B. Reinforcing Steel Mat: ASTM A704/A704M, using ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa) steel bars or rods, unfinished.
- C. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.
- D. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch (1.29 mm).

2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement. Accessories shall be placed in accordance with the CRSI Code unless otherwise noted.

2.02 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Welding of reinforcement is not permitted.
- C. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.
- D. Locate reinforcing splices not indicated on drawings at point of minimum stress.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Reinforcement shall be carefully formed to dimensions on the plans and as recommended in "Details & Detailing of Concrete Reinforcement" (ACI SP-66. Placement of bars shall conform to latest CRSI "Recommended Practice for Placing Reinforcement Bars"), details and detailing of concrete reinforcing ACI 315, and guide for concrete floor and slab construction ACI 302.1-R.
- C. Do not displace or damage vapor barrier.
- D. Metal reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the plans shall not be used.
- E. Accommodate placement of formed openings.
- F. Unless otherwise noted, lap continuous bars 36 diameters, but in any case' not less than 15". Horizontal bars shall continue around corners minimum of 15" unless otherwise noted. Provide corner bars equivalent in size and number to horizontal bars at corners and wall footings and lap with horizontal reinforcement.
- G. Reinforcement shall be free from rust, scale and oil, and shall be accurately positioned and secured against displacement by using annealed wire of not less than No. 16 Ga., or suitable clips at intersections and shall be supported in a manner that will keep all metal away from the exposed surface of the concrete.
- H. Comply with applicable code for concrete cover over reinforcement. The minimum concreted cover shall be: for concrete exposed to the weather 1-1/2" for #5 and smaller, 2" for #6 and larger; 3" for concrete on or below ground; 3/4" in slabs on grade, walls and joists, and 1-1/2" for beams, girders and columns.
- I. Lap mesh a minimum of one grid spacing (plus 2") and ensure that mesh is completely embedded in the concrete approximately 2" from the bottom of the slab.
- J. Dowel masonry foundation walls to concrete entrance aprons and footings minimum of 24 bar diameters into each wall and footing at 24" O.C. with (1) - #5 unless noted otherwise on the plans.
- K. All reinforced pilasters, masonry door openings, bearing walls under beams, etc. shall have vertical foundation/footing dowels extended into walls for full height reinforcing. (From footing to top of masonry wall).
- L. Dowel all exterior concrete slabs/walks into concrete porches and aprons with #4-bars 24" O.C. unless noted otherwise.
- M. Provide reinforcement in top of interior wall footings centered under door and other openings equivalent in size and number to bottom reinforcement and 4 feet longer than opening.
- N. Minimum reinforcement unless noted otherwise:
 1. Walls 8" or less in thickness: #5 at 12" each way centered in wall.
 2. Walls thicker than 8": #5 at 12" each way centered in face.

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3. Slabs on grade or slabs on joists: 6" x 6" W 2.1 x W 2.1 W.W.F.
- O. Bond and ground all reinforcement to requirements of Section 260526.

END OF SECTION

**SECTION 033000
CAST-IN-PLACE CONCRETE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior concrete slabs.
- B. Joint devices associated with concrete work.
- C. Miscellaneous concrete elements, including equipment pads.
- D. Concrete curing.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 031000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- D. Section 032000 - Concrete Reinforcing.
- E. Section 079200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- C. ACI 301 - Specifications for Structural Concrete; 2016.
- D. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- F. ACI 305R - Guide to Hot Weather Concreting; 2010.
- G. ACI 306R - Guide to Cold Weather Concreting; 2016.
- H. ACI 308R - Guide to External Curing of Concrete; 2016.
- I. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
- J. ACI 347R - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- K. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- L. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.
- M. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- N. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.
- O. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- P. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.
- Q. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.
- R. ASTM E1155/E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2023.
- S. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric); 2014.

- T. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
- U. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.
- V. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
 - 1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
- C. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
 - 2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
 - 3. Indicate proposed mix design complies with admixture manufacturer's written recommendations.
- D. Samples: Submit samples of underslab vapor retarder to be used.
- E. Test Reports: Submit report for each test or series of tests specified.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
 - 1. Maintain one copy of each document on site.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Comply with requirements of Section 031000.

2.02 REINFORCEMENT MATERIALS

- A. Comply with requirements of Section 032000.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type. Exterior cement shall be the same with Air-Entraining Admixture, Type 1A, for exterior walks, slabs, etc.
 - 1. Acquire cement for entire project from same source.
- B. Fine and Coarse Aggregates: ASTM C33/C33M. The maximum size of aggregate shall not be larger than 3/4 of the minimum clear spacing between reinforcing bars.
- C. Sand to consist of clean, hard, durable, un-coated grains free from salt, loam and clay. Sand shall be M.D.O.T., Class 2 NS, meeting ASTM C33/C33M.
- D. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

- B. Air Entrainment Admixture: ASTM C260/C260M.

2.05 ACCESSORY MATERIALS

- A. Underslab and Crawl Space Vapor Retarder:
1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Visqueen polyethylene film min. 6 mil (.006") thick, as manufactured by the Visking Co., or approved substitute.
 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
- B. Tactile surface of ramps and crosswalks (sidewalk/paving transitions) with detectable warning strip shall be contrasting solid color pre-manufactured polymer composite tiles as manufactured by Armor-Tile Tactile Systems, 1-800-682-2525 or cast-iron plates as manufactured by East Jordan Iron Works (800) 231-3549. Install units directly into wet concrete without anchors or adhesives in strict compliance with manufacturer's installation instructions. Color as selected by Architect.

2.06 BONDING AND JOINTING PRODUCTS

- A. Water Stops – Multi-ribbed, keyway design and others as detailed on drawings, for non-limited movement as manufactured by Bometals, Inc., Powder Springs, GA, 800-862-4835 or approved equal.
- B. Expansion joint to be fiberboard impregnated with not less than 35% nor more than 50% of asphalt by weight. Joint material to be full thickness of slab or joint and 1/4" thick interior and 1/2" thick exterior, height equal to slab thickness, with removable top section that will form 1/2 inch (13 mm) deep sealant pocket after removal.

2.07 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- D. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 3,000 PSI; Footings, foundations, and interior slabs on grade – 3,500 PSI; Columns – 4,000 PSI; Exterior slabs, walks, curbs, and pads - 4,000 PSI air entrained w/ 4% - 6% air.

2.08 MIXING

- A. Mixing, placing and curing shall conform to ACI 301, ACI 305-R hot weather concreting, and ACI 306-R (cold weather concreting) and ACI 304-R (measuring, mixing and placing). Ready mixed concrete may be used and shall be mixed and delivered in accordance with ASTM 094-55T. Delivery tickets shall be recorded for inspection showing batch No., mix admixtures, time, water content, etc. Submit copies to Architect.
- B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. All existing pavement, walks, curbs and other hard materials shall be saw cut in straight perpendicular/parallel lines in regular geometric patterns. Walk sections and other similar work shall be removed back to nearest control joint for replacement of the full section.
- B. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- C. Verify that forms are clean and free of rust before applying release agent.
- D. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- E. Prepare existing concrete surfaces to be repaired according to ICRI 310.2R.
- F. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout or epoxy as specified.
- G. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches (150 mm). Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Seal around all pipes and other projections piercing vapor barrier. It is suggested that pipe screeds on concrete leveling pads be used for striking off concrete to grade, as no screed stakes will be permitted to puncture vapor barrier. Spot tape in place to prevent movement while installing concrete. Repair damaged vapor retarder before covering.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. Before concrete is placed, all equipment for mixing and transporting concrete shall be cleaned, all debris shall be removed from spaces to be occupied by the concrete, forms shall be thoroughly wetted and oiled, water shall be removed from excavations, and all work to be built into the concrete shall be in place, inspected and approved by the Architect.
- G. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- H. Concrete shall be handled from the mixer to the place of final deposit as rapidly as possible by methods, which shall prevent the separation or loss of ingredients.
- I. Equipment Pads - As specified in the Mechanical/Electrical Divisions and noted on drawings, shall be installed in sizes and locations as coordinated with equipment to be supported. Forms shall be set and Contractor shall receive Architect's approval prior to pouring concrete.
- J. Finish floors level and flat, unless otherwise indicated, within the tolerances specified elsewhere.

3.05 SLAB JOINTING

- A. Locate joints as indicated on drawings. If deviations are required, contractor to provide drawing to Architect for approval.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- D. Control Joints
 1. Exterior Joints in walks to be tooled - no saw-cutting allowed.
 2. Paving and Interior Saw Cut Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch (5 mm) thick blade and cut at least 1 inch (25 mm) deep but not less than one quarter (1/4) the depth of the slab.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. All floors must be free from irregularities, waviness, rough spots and any other defects, with maximum variation of 1/8" in 10' diameter.
- B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
 1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, on-grade only.
 2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
 3. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
 4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.
- C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155/E1155M (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.
- D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
- E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch (6 mm) or more in height.
- C. All exposed surfaces when forms are stripped shall be sealed with a light cement sand mixture. Thoroughly wet surfaces and rub with burlap to fill all air pockets and voids.
- D. Chamfer all exposed edges $\frac{3}{4}$ " x 45 degrees
- E. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
 1. Screed floors to proper level, float and trowel. After floating to proper level, allow concrete to stand until all water sheen has disappeared. Do finish troweling with steel trowel after concrete is so hard that no mortar accumulates on the trowel and a ringing sound is produced as the trowel is drawn over the surface.
 2. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

3.08 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Surfaces Not in Contact with Forms:

1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
2. Final Curing: Begin after initial curing but before surface is dry.

3.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 50 cubic yards (38.23 cu m) or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.10 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.11 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

**SECTION 040511
MASONRY MORTARING AND GROUTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 042000 - Unit Masonry: Installation of mortar and grout.

1.03 REFERENCE STANDARDS

- A. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.
- B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2018.
- C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
- D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- E. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- F. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.
- G. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2017.
- H. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
- I. ASTM C476 - Standard Specification for Grout for Masonry; 2020.
- J. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2020.
- K. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- L. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.
- M. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
- C. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.
- D. Reports: Submit reports on grout indicating compliance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.06 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

- A. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.
- B. Mortar Color: Shall be standard gray or if patching/addition, shall be tinted in color and ratio of mix adjusted as required throughout to match existing. Provide Sample for Architect's approval.
- C. Mortar Mix Designs: ASTM C270, Property Specification.
 - 1. Mortar shall comply with ASTM C91 and C-270 in all respects of property and proportion specifications. Below grade and above grade shall be Type "M" or "S" - 1,500 PSI. Masonry cements will be permitted that meet or exceed ASTM C 1329-96. No anti-freeze agents are allowed. Tuckpointing and patching/repair mortars shall be similar in characteristics to what originally used. Prepare sample mix for Architect's approval.
 - 2. Masonry below grade and in contact with earth: Type S.
 - 3. Exterior Masonry Veneer: Type N.
 - 4. Exterior Cavity Walls: Type S mortar with Type N pointing mortar.
 - 5. Interior, Loadbearing Masonry: Type N.
- D. Grout Mix Designs:
 - 1. Grout – For use under bearing plates and anchor bolts shall be construction grade, non-ferrous, non-gaseous, non-shrink, #CG-86 as manufactured by W.R. Meadows, Seal Tite-Elgin, IL (1-847-683-4500). Foundation grout shall comply with ASTM C476 and have minimum strength of 2000 PSI.
 - 2. Bond Beams and Lintels: 3,000 psi (21 MPa) strength at 28 days; 8-10 inches (200-250 mm) slump; provide premixed type in accordance with ASTM C 94/C 94M.

2.02 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
- B. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
- C. Portland Cement: ASTM C150/C150M.
 - 1. Type: Type I - Normal; ASTM C150/C150M.
 - 2. Color: Standard gray.
- D. Masonry Cement: ASTM C91/C91M.
 - 1. Type: Type N; ASTM C91/C91M.
- E. Hydrated Lime: ASTM C207, Type S.
- F. Quicklime: ASTM C5, non-hydraulic type.
- G. Mortar Aggregate: ASTM C144.
- H. Grout Aggregate: ASTM C404.
- I. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
- J. Water: Clean and potable.

2.03 MORTAR MIXING

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.

- C. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio; mix in accordance with manufacturer's instructions, uniform in coloration.
- D. Do not use anti-freeze compounds to lower the freezing point of mortar.
- E. If water is lost by evaporation, re-temper only within two hours of mixing.

2.04 GROUT MIXING

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Lay units in full beds of mortar, plumb, true to line and level. Make joints uniform approximately 3/8" and as required to match existing for patching work. Remove units and relay in fresh mortar when shifting or realignment is necessary. Tool all "interior and exterior" joints above grade to slightly concave, smooth, compact surface, using correct tool. Exterior joints below grade shall be trowel pointed. All mortar shall be used within two hours after mixing or after it has begun to set.
- B. Build in all required miscellaneous metal and other items. Set any and all loose lintels and bed structural bearings in mortar to line and level. Install all bolts, lintels, anchors, plates, etc., as shown or required. Provide all expansion and control joints in walls were shown. If not shown, maximum length of wall between control joints to be 20' o.c. Expansion joints shall be installed at all areas where new masonry wall intersects existing wall and maximum 120'-0" o.c. Install Galvanized Metal Joint Stabilizer Anchor #1700 as manufactured by "Masonry Reinforcing Corp. of America 2'-0" o.c. vertically. Reinforcing shall not extend through expansion joints.
- C. Do not lay mortar when temperature of surrounding atmosphere is below 32 degrees F. or is likely to fall below 32 degrees F. in the twenty-four hour period after laying, unless adequate protection is provided. At temperatures below 32 degrees F., provide adequate equipment for heating materials. Protect all finished work against freezing for a period of not less than forty-eight hours by means of enclosures, artificial heat or such other protective methods as may be required.

END OF SECTION

**SECTION 042000
UNIT MASONRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Clay facing brick.
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 040511 - Masonry Mortaring and Grouting.
- D. Section 071113 - Bituminous Dampproofing: Dampproofing parged masonry surfaces.
- E. Section 078400 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
- F. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016, with Editorial Revision (2018).
- B. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016a.
- C. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2021.
- D. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.
- E. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
- F. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
- G. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- H. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.06 MOCK-UPS

- A. Construct a masonry wall as a mock-up panel sized 8 feet (2.4 m) long by 6 feet (1.8 m) high; include mortar, accessories, structural backup, and flashings (with lap joint, corner, and end dam) in mock-up.
- B. Locate where directed.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depths as indicated on drawings for specific locations.
 - 2. Masonry Units - Standard units with crushed stone aggregate, clean cut corners and true dimensions. Average percentage of moisture in units shall not exceed 40% of their total absorption at time of setting. Units shall have a minimum compressive strength of 1,500 lbs. PSI of gross area at twenty-eight days or when delivered to the job. Provide special blocks for corners, concrete joints, bullnose, piers, control joints, etc., as may be required. Regular blocks will not be permitted for corners, even below grade. To conform to ASTM C-90-94b latest edition and TMS 402/602, Grade N-1. Firewall units shall meet N.C.M.A., equivalent thickness method and supplied in wall thickness noted.
 - 3. Pre-insulated Masonry units, in addition, shall have expanded polystyrene individually molded to have a minimum density of 1.3 P.C.F., and shall conform to ASTM C578 Standard Type X.

2.02 BRICK UNITS

- A. Facing Brick: "Modular Concord Clear #20-19" as manufactured by The Belden Brick Company, 700 Tuscarawas St. W., Canton, OH., 44702 and Supplied by Tri County Block & Brick Inc., 1628 US 20 Alternate, Swanton, OH. 43558; (419)826-7060; www.tricountyblock.com.

2.03 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 040511.

2.04 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing - Horizontal wall reinforcing shall be #9 Ga. type 304 stainless steel trussed wires of not less than 3/16" diameter hook and eyes, manufactured by Hohmann & Barnard, Inc., Haven-Busch Co., or equal. Width shall be within 1" of surface of the walls - brick and block. For block only walls, or block/brick walls installed at same time, use (1) piece 120 Truss-Mesh. For block/brick walls installed separately when damp proofed, parged, and/or rigid insulation is installed, use (2) piece Hohmann & Barnard, Inc, Lox-All adjustable joint reinforcement 170-2X Truss Eye-Wire with #9 Ga. type 304 stainless steel wire truss and anchors 16" x 16" and separate hook loops of 3/16" thick, type 304 stainless steel. Reinforcing to be wider with cavity wall insulation, as the eyes shall project just through insulation so the insulation is held tight to the block with the tails of the brick hooks.
- B. Anchor Bolts - Minimum 1/2" diameter x 12" hooked, or as noted on drawings. Material shall be as approved by the treated wood manufacturer, i.e, stainless steel, epoxy coated steel, etc.
- C. Existing Masonry Anchors - shall be "Heckmann" or equal #133 vertical channel-slot bars anchored with #133-P bridge plate to existing block, 32" O.C. vertically. Install vertical slots 16" O.C. horizontally. Set new brick with keyed corrugated ties, #134, at 16"x16" O.C. Finish to be hot dipped galvanized.

2.05 FLASHINGS

- A. Masonry Base Course & Sill Flashing – Shall be a composite of copper fabric flashing as manufactured by Wasco/York manufacturer series #201. Shall consist of 5 oz. full sheet of copper coated with reinforced glass/asphaltic fabric on both sides - permanently bonded together. No PVC flashing allowed.

2.06 ACCESSORIES

- A. Expansion Joints- shall be #3300 Vertical as manufactured by Masonry Reinforcing Corp. of America with standard sash blocks. Both sides of joint to be rod filled and caulked. Install angle or galvanized joint stabilizer as shown on drawings.
- B. Control Joints – Shall be Block-Tite Formed Rubber "T" #AA 2005, as manufactured by AA Wire with standard sash blocks. Both sides of joint to be rod filled and caulked.

- C. Mortar Net - Thickness of cavity (minimum 0.4" thick) x 10" high x 5' long, as manufactured by Mortar Net USA LTD, Highland, Indiana 46322 (1-800-664-6638), or approved equal.
- D. Weep Tubes - #3600I stainless steel filter and wick as manufactured by Wirebond, 400 Rountree Rd., Charlotte, NC. 28217 or approved Equal
- E. Cavity Vents:
 - 1. Type: Extruded propylene with honeycomb design.
 - 2. Color(s): As selected by Architect from manufacturer's full range.
 - 3. Manufacturers:
 - a. Mortar Net Solutions; Cell Vent: www.mortarnet.com/#sle.
 - b. WIRE-BOND; Cell Vent: www.wirebond.com/#sle.
 - c. Masonpro; Cell Vent: www.masonpro.com.

2.07 CLEANING

- A. Shall be as recommended by the masonry supplier, non-toxic, non-hazardous, equal to Sure Klean, as manufactured by Prosoco. Change cleaner type and adjust mix as required to clean different masonry/stone/concrete/clay materials. Submit type/mix for each masonry material for approval in the shop drawing phase.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 PLACING AND BONDING

A. BRICK UNITS

- 1. Lay all units in running bond with all work laid in modular dimensions or as shown on drawings. Pieces shall be kept to a minimum. Note any special brick work - soldier course bands, Rolok sills, etc. Miter sills, headers, corners, etc., to eliminate exposure of unfinished brick surfaces. Where applicable lay all units in bond to match existing.
- 2. Thoroughly wet "high suction" bricks before laying to obtain proper bond. Do not lay dry.
- 3. Brick/Mortar Patching - Existing brick shall be re-worked as noted to allow for new framing to anchor to existing. Also patch/replace brick in existing wall where openings are filled-in. Toothing in all work, remove all cut/non-full size units, and lay up new work to provide a final uniform appearance without evidence of patching. Install horizontal dowels/rebars into existing horizontal reinforcing and other anchors, for proper lateral stability.
- 4. When installing brick over wood studs, anchor with brick ties 16" on center vertically and horizontally. Anchor ties to wood studs (thru sheathing) with 1-1/2" galvanized roofing nails. Bend ties down toward brick to drain and not catch/trap water at bend.
- 5. Brick Replacement - In all areas of existing building where left exposed to view on exterior, the existing brick is to be removed and new added. Provide and install new anchoring system with slotted channels and keyed ties with anchors spaced 16"x16" O.C. Install brick with weeps, flashings, mortar net, asphaltic water proofing, etc. All as specified for new.

B. CONCRETE MASONRY UNITS

- 1. Lay all block units in running bond with all work laid in modular dimensions or as shown on drawings. Pieces shall be kept to a minimum coursing to match existing.

2. Provide neatly cut and fitted units around all plumbing pipes, electrical and similar items. Install PVC sleeves around pipes, tiles, etc., below or above grade.
3. All walls having full frost foundations shall be toothed into all intersecting walls at every other course, including the interior walls meeting exterior walls, porch foundations, etc. All interior walls bearing on slabs abutting walls bearing on foundations shall not be toothed with masonry. Provide lateral stability using corrugated galvanized wall ties 16" on center vertically, while allowing vertical movement. All intersecting walls bearing on slab shall be toothed similar to all walls bearing on foundations.
4. Verify location and size of all steel lintels, jambs, beams and other steel or mechanical work as supplied by others and install same. Cut all openings into existing masonry and rework as noted/required for new grills, ducts, windows, doors, enlarged openings, etc.
5. Provide and install bullnose, rounded corner, blocks at all doorways, outside corners, openings, etc., when not covered by drywall and where called for on the drawings. Verify all conditions with types of door frames and steel jambs specified elsewhere.
6. Install foundation block working around all vertical reinforcing bars, extending from footings. Grout cores of entire foundation blocks solid.
7. Brick seats shall be constructed with 12"x 8"x 16" grade block, 8"x 8" x 16" semi solid, or all exposed cores shall be filled with grout for solid flat bearing of fabric flashing and brick. Stop brick seats as required so a minimum of (2) courses fall below exterior finish grade.
8. Provide and install a bond beam around entire building perimeter at height as noted on drawings, with steel reinforcing and grouted full. Use special bond beam masonry units.
9. For small piers, pilasters, or corners having concentrated bearing, grout blocks full height to footing 24" from bearing edge and rod with 2-#5 vertical bars minimum with #2 horizontal stirrups 16" o.c. vertically, or as detailed. Pilasters shall be laid at same time as wall and integral with same.

3.04 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches (600 mm) on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 32 inches (800 mm) on center horizontally below shelf angles and lintels, near top of walls, and above all flashing locations.

3.05 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions.

3.06 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

- A. Reinforce all masonry walls below and above grade with trussed wires at every 2nd course (16") and shall be so laid out that one layer shall come in the course above lintels. Longitudinal wire shall be lapped not less than 12" at corners, cut inside rod and bend to proper angle. At each doorway reinforce first two courses above opening and reinforcing extending not less than 3" beyond each jamb. Where concrete block is to be waterproofed on exterior and before installing brick, install (2) piece type horizontal reinforcing, being sure to install full horizontal reinforcing in block as well as brick with "U" type wire anchors 16"x 16" on center.
- B. Set all hooked anchors for wood framing/roof plates - shall be minimum 4'-0" on center; 2'-0" from corner; 1'-0" from edges of all doors/openings, etc. Grout cores of block solid.

3.07 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

- B. Base Course Flashing - Shall be installed in strict accordance with manufacturer's specifications and recommendations and detailed drawings. Fabric must be laid in fresh mortar bed – above and below fabric without voids. Fabric shall be lapped at least 6" at all end joints with a liberal coating of bonding agent. Ample mastic shall be used at all turn-ups and at all locations to thoroughly bond the fabric to the brick. Install at brick seat, above door and window lintels, under windowsills approximately 8", 12" above projected rooflines, and other condensation ledges in areas as recommended by the manufacturer and shown on the drawings. Top edge of fabric shall be laid into block coursing a minimum of 16" above weep ledge. On wood framing, install under wood sill plate and lap with sheathing vapor barrier. At all discontinuous ends, such as at the ends of windows, beams, doors, etc., form end dams by turning up fabric to prevent water from spilling over ends. Angle cut ends at 30° ± slope to reduce exposed edge of dam in vertical exposed face of masonry. The fabric shall be fully supported on bottom side without dips and laid to drain water outward. Fill all voids/cavities below flashing with mortar. Weeps shall be installed on top of flashing 24" o.c. and at all ends.

3.08 INSULATION

- A. See Division #7 for masonry insulation. Contractor shall notify and receive Architect's approval of having insulation full height in walls before top of wall is capped, bond beam is placed, or other features are installed where blocked from view. Protect tops of all filled walls with poly covering from elements of the weather. All exterior block walls receive foam-in-place insulation.

3.09 LINTELS

- A. Install all structural steel hooked bearing plates, joist stirrups, etc. Under all steel beam and lintel bearings, grout blocks solid for a minimum of three courses below and 24" back from bearing edge.
- B. Install all steel lintels as noted on drawings.
- C. Provide and install any miscellaneous pre-cast lintels for minor items (mechanical and electrical), if no steel lintel is specified. Lintels shall be constructed of 2,500# concrete, manufactured from same materials and texture as wall to comply with reinforcing standards as established by the Concrete Products Association of Michigan..

3.10 CONTROL AND EXPANSION JOINTS

- A. Control joints and expansion joints shall be in locations and constructed as noted on the drawings. Rod and grout block cores on each side with minimum #4 re-bars. Install formed rubber unit continuous from grade to roof and full width of wall, less depth for foam rod and caulking both sides. Barb of rubber unit shall extend into masonry units (sash blocks).
- B. Do not continue horizontal joint reinforcement through control or expansion joints.
- C. Size control joints as indicated on drawings; if not indicated, 3/4 inch (19 mm) wide, fullwidth of wall, max. 40'-0" o.c. spacing as directed by architect.
- D. Control joints at juncture of new walls to existing shall be laterally braced, using full height steel angle bolted to existing - minimum 2'-0" on center, using 1/2" diameter expansion anchors. Install formed rubber cushion adjacent to angle and fill remaining void/core of masonry unit with grout and re-rod. Separate with felt layer for isolation and movement.

3.11 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames, work hose bibs, gas vents, electrical outlets, and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

3.12 PARGING

- A. Seal all blocks below grade on exterior side with 3/8" parge coating of portland cement mortar. Below grade shall in addition be sealed with asphaltic waterproofing compound. No voids or pores shall be visible. Above grade block in cavity walls shall be sealed as a vapor barrier with asphaltic damproofing without parge coating. (See Division #7).

3.13 CLEANING

- A. Clean brick in strict conformance with cleaner manufacturer's specifications and recommendations. Leave surfaces free from mortar and other stains at completion of work. Use mild cleaning solution to wash down brickwork and excess mortar. Install cleaner/wash a sample area for Owner/Architect approval before proceeding with remaining work. Do not permit cleaner to come in contact with metal or aluminum. Wire brush as required to assist cleaning. Thoroughly rinse brick with water after washing.

END OF SECTION

**SECTION 051200
STRUCTURAL STEEL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural steel framing members.
- B. Structural steel support members and struts.
- C. Lintels
- D. Grouting under base plates.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 053100 - Steel Decking: Support framing for small openings in deck.
- D. Section 055000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; 2017.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- F. ASTM A242/A242M - Standard Specification for High-Strength Low-Alloy Structural Steel; 2024.
- G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
- I. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2015.
- J. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2007 (Reapproved 2013).
- K. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2020.
- L. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
- M. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019, with Editorial Revision (2020).
- N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- O. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2014, with Errata (2015).
- P. SSPC-SP 3 - Power Tool Cleaning; 2024.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:

1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 2. Connections not detailed.
 3. Indicate cambers and loads.
 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- D. Steel fabricator to design beam connections for reactions indicated or where not indicated, one half of total uniform load capacity of a simple beam for span given as specified in latest AISC Manual of steel construction. Design connections of bracing members for member forces indicated, or where not indicated, for the full tensile and compressive capacities of the bracing member.
- E. Members shall be of dimensions and weights shown on drawings. Substitutions of other sections may be made, subject to the Architect's approval and provided that no change is made to architectural design and that the substituted sections are at least equal to the original design in strength and stability.

1.05 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B. Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 051213.
- C. Maintain one copy of each document on site.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Structural steel shall conform to the latest edition of Specifications for Structural Steel Buildings allowable stress and plastic design, AISC; allowable stress design of single-angle members, AISC; structural joints using ASTM A325 or A 490 bolts, RCSC; standard code of practice, AISC.
- B. Steel Angles and Plates: ASTM A36/A36M.
- C. Steel W Shapes and Tees: ASTM A992/A992M.
- D. Rolled Steel Structural Shapes: ASTM A992/A992M.
- E. Steel Shapes, Plates, and Bars: ASTM A242/A242M high-strength, corrosion-resistant structural steel.
- F. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
- G. Pipe: ASTM A53/A53M, Grade B, Type E or S.
- H. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M Class C.
- I. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 or ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
- J. Anchor Bolts - ASTM A307 or A36
- K. Furnish angle lintels for new doors, windows, miscellaneous openings, mechanical equipment and duct openings as noted on drawings or required to complete this work. Steel angles, unless noted otherwise, to be minimum (2) – 3 ½" x 3 ½" x ¼" angles for 4' spans and (2) 5 ½" x 3 ½" x ¼" angles for 8' spans in 8" thick walls and (3) of same angles in 12" thick walls. For roof openings, unless noted otherwise, provide and install 'H' frame of 3 ½" x 3 ½" x ¼" angle spanning between existing structural members.
- L. Furnish adequate bearing plates with anchors for all steel beams bearing on masonry. Minimum of 6" bearing of all lintels, beams, etc., on masonry; 4" minimum bearing on

steel, unless noted otherwise. Provide all brick angle lintels for all windows, doors and miscellaneous openings.

- M. Provide all hangers, attachments, etc., in connection with lintels and other structural steel.
- N. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch (13.7 MPa).
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch (48 MPa).

2.02 FABRICATION

- A. Fabricate structural steel in accordance with current edition of Specifications adopted by the American Institute of Steel Construction. Do all punching and drilling of steel required for attachment of other materials thereto.
- B. Provide all hangers, attachments, etc., in connection with lintels and other structural steel.
- C. Shop fabricate to greatest extent possible.

2.03 FINISH

- A. Prepare structural component surfaces in accordance with SSPC-SP 3.
- B. All steel beams, miscellaneous steel, etc.(other than fireproofed, field welded, or high strength bolted.), shall have one heavy coat of rust inhibitive paint applied in the shop. It shall be clean of all rust, scale, sand and other foreign matter before painting. Patch paint in the field in case of damage due to welding, installation, etc. Note: any concealed lintels/beams built into masonry or concrete, shall be field painted with (2) coats of alkyd paint before installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC 303.
- B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Connections, except as otherwise noted or shown, shall be riveted or welded; field connections may be bolted, unless otherwise noted. Bolted field connections for main members only shall be made with 3/4" ASTM A325 high strength bolts and shall conform to the "Specifications for Structural Joints, using ASTM A325 or A490 Bolts". All other connections may be made with 3/4" standard machine bolts meeting ASTM A307. Shop connections may be riveted, welded or bolted with high strength bolts. Beams shall frame into the side of columns, unless shown otherwise on plans.
- D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
- E. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for non-shrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

END OF SECTION

**SECTION 053100
STEEL DECKING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof deck.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements

1.03 REFERENCE STANDARDS

- A. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021.
- B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- C. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.
- D. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems; 2022.
- E. ICC-ES AC70 - Acceptance Criteria for Fasteners Power Driven into Concrete, Steel and Masonry Elements; 2016.
- F. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.
- G. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

1.05 QUALITY ASSURANCE

- A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 STEEL DECK

- A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
 - 1. Calculate to structural working stress design and structural properties specified.
- B. Roof Deck: Non-composite type, fluted steel sheet:
 - 1. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS, Grade 33, Type 1.
 - 2. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
 - 3. Match existing for size, profile, thickness.

2.02 ACCESSORY MATERIALS

- A. Welding Materials: AWS D1.1/D1.1M.
- B. Fasteners: Galvanized hardened steel, self tapping.
- C. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of ICC-ES AC70.

1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI (DM) design method for roof deck and floor deck applications and ICC-ES AC43.
- D. Weld Washers: Mild steel, uncoated, 3/4 inch (19 mm) outside diameter, 1/8 inch (3 mm) thick.
- E. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On concrete and masonry surfaces provide minimum 4 inch (100 mm) bearing.
- C. On steel supports provide minimum 1-1/2 inch (38 mm) bearing.
- D. Weld deck in accordance with AWS D1.3/D1.3M.
- E. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION

**SECTION 055000
METAL FABRICATIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.
- B. Any miscellaneous metals as required for installation of work by other trades. Included are clip angles, closure plates, nosings, door jamb channels, guard posts/bollards, etc., in sizes and type as shown etc.
- C. Wall Corner Guards: Surface Mounted

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements

1.03 REFERENCE STANDARDS

- A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- G. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.
- H. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- I. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- J. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- K. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021.
- L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- N. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.

- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Stainless Steel, General: ASTM A666/A666M, Type 304.
- F. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch (1.59 mm) minimum metal thickness, 1-1/2 inch (38 mm) diameter.
- G. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
- H. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- I. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- J. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Bolts, Nuts, and Washers: Stainless steel.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

- A. Fabricate metal work with sharp lines, angles, true and plumb-weld all connections, not otherwise shown, and fill smooth for painting any exposed surfaces.
- B. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- C. Joist Hangers: Strap anchors, fabricated with sheet steel, 18 gauge, 0.0478 inch (1.21 mm) minimum base metal thickness; galvanized finish.
- D. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

2.05 WALL CORNER GUARDS - SURFACE MOUNTED

- A. Material: Type 304 stainless steel, No. 4 finish, 16 gauge, 0.051 inch (1.291 mm) thick.
- B. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
- C. Width of Wings: 3 inches (76 mm).
- D. Corner: Square.
- E. Length: One Piece - 6' min. unless noted otherwise on plans. Mounting
- F. Height: as noted on plans or if not noted, bottom set at top of floor base.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation of metal shall be compatible with the adjacent materials. Provide any necessary spacers, isolators, shims, anchors, etc.
- B. Install items plumb and level, accurately fitted, free from distortion or defects.
- C. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Obtain approval prior to site cutting or making adjustments not scheduled.

END OF SECTION

**SECTION 055133
METAL LADDERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prefabricated ladders.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. 077200 - Roof Accessories: Roof Hatch

1.03 REFERENCE STANDARDS

- A. 29 CFR 1910.23 - Ladders; current edition.
- B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2018.
- C. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- D. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.
- E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021.
- F. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- G. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- H. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
- C. Specimen warranty.
- D. Executed warranty.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for material and workmanship. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B211/B211M, 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6061 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
- F. Aluminum-Alloy Die Castings: ASTM B85/B85M .

- G. Bolts, Nuts, and Washers: Stainless steel.
- H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.02 PREFABRICATED LADDERS

- A. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
 - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
 - 2. Materials: Aluminum; 6063 alloy, T52 temper.
 - 3. Finish: Mill finish aluminum.
 - 4. Manufacturers:
 - a. Alaco Ladder Company; 560 Series Fixed Wall Ladder: www.alacoladder.com/#sle.
 - b. Precision Ladders, LLC; Fixed Aluminum Wall Ladder: www.precisionladders.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. Install per manufacturer's recommendations and details.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

**SECTION 061000
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof-mounted curbs.
- B. Preservative treated wood materials.
- C. Fire retardant treated wood materials.
- D. Communications and electrical room mounting boards.
- E. Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
- C. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2018.
- F. PS 20 - American Softwood Lumber Standard; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.

- C. Rough lumber shall be grade #2 or better, dressed four sides, of spruce, pine, douglas fir, or equal, in shapes and sizes as required.
- D. Structural lumber shall be grade #2 or better kiln dried, 1,000 psi bending, unless noted elsewhere (spruce/pine/fir).
- E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

- A. General Plywood shall be CDX Grade, with exterior glue - such as 1/2" thick shall be 4 ply.

2.04 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 - 3. Anchors: Toggle bolt type for anchorage to hollow masonry.
 - 4. Install all work with nails, spikes, screws, joist hangers and similar items of approved sizes and types. Exterior framing anchors to be galvanized.
- B. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.

2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
 - 1. Interior Type A: AWWA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes. Each piece of lumber and plywood shall be U.L. labeled. Install per code requirements.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat rough carpentry items as indicated .
 - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
- C. Preservative Treatment:
 - 1. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber exposed to weather.
 - c. Treat lumber in contact with roofing, flashing, or waterproofing.
 - d. Treat lumber in contact with masonry or concrete.
 - 2. Preservative Pressure Treatment of Plywood Above Grade: AWWA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
 - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.

3. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, 1,200 psi construction grade, Commodity Specification A using waterborne preservative.
 - a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.
 - b. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA) in exposed exterior applications subject to leaching.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.
- C. Install all temporary guardrails, walks, forms, bracing, shoring, etc., as required for the work or safety.
- D. Install any necessary temporary enclosures for door openings, barricades, etc., to close off work for security or moisture/temperature protection.
- E. See Concrete Division #3 for formwork.
- F. Unless otherwise noted, install all nailers or plates on beams or masonry walls per Michigan Building Code and secure with 1/2" diameter bolts, spaced 4'-0" on center with (2) anchors minimum per piece and not closer than 4" or greater than 12" from each end. Provide and install nuts/washers/plates of proper size per code.
- G. Provide all necessary framing around ductwork, registers, vents, etc. Included are nailers and blocking for drywall, cabinets, grab bars, handrails, toilet partitions, window drapes (2x12 each side of window), etc.
- H. Provide and install fire blocking in walls at 10'-0" height, at ceiling lines, behind soffits, around modular tub/shower units, etc., as noted or required by code. Draft stops shall consist of 1/2" CDX plywood.

3.02 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.03 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where specifically indicated otherwise; form corners by alternating lapping side members.

END OF SECTION

**SECTION 071113
BITUMINOUS DAMPPROOFING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Bituminous dampproofing.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements

1.03 REFERENCE STANDARDS

- A. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- B. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2019.
- C. NRCA (WM) - The NRCA Waterproofing Manual; 2005.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide properties of primer, bitumen, and mastics.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.01 BITUMINOUS DAMPPROOFING

- A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
 - 1. Asphalt-Base Emulsion for Metal Protective Coating: ASTM D1187/D1187M, Type I - Continuous water exposure within few days after drying or Type II - Continuous weather exposure after drying.
 - 2. Emulsified Asphalt for Roofing Protective Coating: ASTM D1227/D1227M, Type II, Class 1 - Mineral colloid emulsifying agents with non-asbestos fibers.
 - 3. VOC Content: Not more than permitted by local, State, and federal regulations.
 - 4. Applied Thickness: 1/16 inch (1.5 mm), minimum, wet film.
 - 5. Products:
 - a. W. R. Meadows, Inc; Sealmastic Emulsion Type II (brush/spray-grade): www.wrmeadows.com/#sle.
 - b. Sonneborn; Hydrocide 700B

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive dampproofing.
- B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
- C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION

- A. Install per manufacturer's recommendations on all exterior side of block foundations below grade and on exterior side of exterior block walls from top of block at roof to brick seat (between block and brick walls). Masonry surface to receive dampproofing shall be dry and clean of all mud, dirt and loose mortar. Spray or brush on dampproofing for 100% coverage with no voids (total 1/8" minimum thickness). The spray system shall also be back-rolled. A minimum of (2) coats shall be applied to achieve the required thickness – thoroughly dried between coats.
- B. Asphaltic Coating may be installed in partial heights as block wall is installed. Dur-O-Wall reinforcing will protrude from block and care shall be taken to coat around all wires entering into block. Brick installation to follow.
- C. Perform this work in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- D. Prime surfaces in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- E. Apply bitumen with mop.
- F. Seal items watertight with mastic, that project through dampproofing surface.

END OF SECTION

**SECTION 072100
THERMAL INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Batt insulation for sound.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements

1.03 REFERENCE STANDARDS

- A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- C. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C; 2019a.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Sound Insulation in stud cavities shall be unfaced in width to fill stud cavity.
- C. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 2. Formaldehyde Content: Zero.
 - 3. Products:
 - a. CertainTeed Corporation: www.certainteed.com/#sle.
 - b. Johns Manville: www.jm.com/#sle.
 - c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
- D. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 - 2. Products:
 - a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
 - b. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

- A. Install all insulation as recommended by the manufacturer without misses.
- B. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- C. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Contractor to call for and receive Architect's inspection/approval of all insulation before covering up.

END OF SECTION

SECTION 075323
EPDM THERMOSET SINGLE-PLY ROOFING - CARLISLE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Adhered roof system with ethylene propylene diene monomer (EPDM) roofing membrane.
- B. Insulation, flat and tapered.
- C. Flashings.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements

1.03 REFERENCE STANDARDS

- A. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015.
- B. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; 2016, with Editorial Revision (2022).
- C. NRCA (RM) - The NRCA Roofing Manual; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's written information listed below.
 - 1. Product data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
- C. Shop drawings must be submitted to Carlisle by the Carlisle Authorized Roofing Applicator along with a completely executed Notice of Award (Page 1 of Carlisle's Request for Warranty form) for approval. Approved shop drawings are required for inspection of the roof and on projects where on-site technical assistance is requested.
- D. Shop Drawings must include:
 - 1. Outline of roof and size
 - 2. Deck type (for multiple deck types)
 - 3. Location and type of all penetrations
 - 4. Perimeter and penetration details
 - 5. Key plan (on multiple roof areas) with roof heights indicated
 - 6. Sure-Seal Fastener type, length and maximum spacing or Fast Adhesive ribbon spacing (for insulation securement)
 - 7. Tapered insulation layout plan showing insulation thicknesses, slopes with flow directions, drain and cricket locations, rooftop equipment locations, flashing locations and heights above finished roof, and all other information as to determine that all warranties can be obtained based on new and existing conditions of the proposed and/or required work.
- E. Along with the project submittals (shop drawing and Request for Warranty), the roofing contractor must include pullout test results when the results are below the requirements identified in the Table included in Design Reference DR-06-11 "Withdrawal Resistance Criteria".
- F. Upon completion of half the project, the contractor shall notify Carlisle and pay any fee to make "mid-way inspection" to ensure work is being installed per the manufacturer's standard details. Note: no more than 50% of the contact amount will be paid to the Contractor prior to this inspection being made by the roofing manufacturer.
- G. After project completion, the Contractor must be submitted a Notice of Completion, (Page 2 of the Carlisle Request for warranty form) to Carlisle to schedule the necessary inspection and

acceptance of the project prior to issuance of the Carlisle warranty. An inspection shall be made by a representative of Carlisle SynTec Systems in order to ascertain that the Roofing System has been installed according to Carlisle SynTec System's published specifications and details.

- H. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- I. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and other supplementary instructions.
- J. Warranty:
 - 1. Upon approval of the installation, Carlisle shall submit a watertight full system guarantee for twenty (20) years against defects due to material or workmanship. This shall not be construed to cover misuse or abuse. The warranty shall include wind speed (Maximum Peak Gusts) up to 72 mph. Also, a manufacturer's guarantee shall be submitted for twenty (20) years on the membrane materials.
 - 2. Total System Warranty - Contractor shall state the amounts on the bid proposal form to provide and install only materials from among those supplied or approved by Carlisle for the total roofing system. All components of the entire roofing system are to be products of the manufacturer or accepted by the manufacturer as compatible. Upon approval of the installation, the manufacturer shall submit their standard full systems guarantee for (20) years against defects due to material or workmanship and their standard guarantee on membrane material - both by manufacturer. This shall not be construed to cover misuse or abuse. The Contractor shall list the manufacturer's name of the roofing system bid on the total system bid proposal form.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty (20) years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this section:
 - 1. With minimum five years documented experience.
 - 2. Franchised Installer - Roofing Contractor shall be franchised installers by the manufacturer of the roofing system.
 - 3. Experience - Roofing Contractor shall have been in the roofing business for the last five, (5) years as Roofing Installers. Contractor shall have a minimum of 5 years' experience and have installed a minimum of five, (5) re-roofs similar to this project size or larger using the materials and manufacturers as herein specified. Written verification shall be submitted with bid proposal, stating references and jobs similar in scope of this project.
 - 4. Location - Roofing Contractors shall be located within approximately a fifty (50) mile radius of the City of Monroe, Michigan.
 - 5. Worker's Qualifications:
 - a. Workmanship shall be of the highest standard throughout and in accordance with the latest and best standard practices of the trade. Only skilled workmen in the task assigned them shall be employed.
 - b. A Roofer shall have a minimum of two years' experience installing the material herein specified, or certification from the roofing manufacturer or from a Federal or Michigan State approved program, or trade school, or certification from a local trade union having the classification of a journeyman.
 - c. A Roofer's helper shall be anyone performing roofing related work (excluding the installation of roofing materials), such as tear-offs, carrying materials, mixing materials, cleaning up, etc.
 - d. An apprentice Roofer is one who is registered in a bonafide program as registered with the U.S. or State of Michigan Department of Labor.
 - e. The proportion of apprentices and helpers shall not exceed (1) helper and/or (1) apprentice to every (3) Roofers. An apprentice may do the work of a helper.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- B. Protect products in weather protected environment, clear of ground and moisture.
- C. Protect foam insulation from direct exposure to sunlight.
- D. Keep Safety Data Sheets (SDS) at the project site at all times during transportation, storage, and installation of materials.
- E. Comply with requirements from Owner to prevent overloading or disturbance of the structure when loading materials onto the roof.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
 - 1. Warranty Term: 20 years.
 - 2. For repair and replacement include costs of both material and labor in warranty.
 - 3. Exceptions NOT Permitted:
 - a. Damage due to roof traffic.
 - b. Damage due to wind of speed greater than 56 mph (90 km/h) but less than 90 mph (145 km/h).

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Carlisle SynTec: www.carlisle-syntec.com/#sle.
- B. The following roofing system manufacturers, in addition to Carlisle, have submitted written documentation of products, guarantee, testing, etc., and are approved by the Architect.
 - 1. Firestone "Rubbergard" Fully Adhered 60 Mil
- C. Substitutions: See Section 016000 - Product Requirements.

2.02 ROOFING APPLICATIONS

- A. Furnish and install Bonded, Sure Seal, Design "A" Rubber Membrane Roofing System indicated on drawings and specified herein.
- B. Roofing Assembly Performance Requirements and Design Criteria:

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

- A. Membrane:
 - 1. Material: Ethylene propylene diene monomer (EPDM); ASTM D4637/D4637M, Type I (non-reinforced).
 - 2. Thickness: 60 mil, 0.060 inch (1.5 mm), minimum.
 - 3. Sheet Width: Factory fabricated into largest sheets possible.
 - 4. Color: Black.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Flexible Flashing Material: Same material as membrane.
- D. Base Flashing: Provide waterproof, fully adhered base flashing system at all penetrations, plane transitions, and terminations.

2.04 INSULATION

- A. Standard insulation on metal deck shall be nominal 2.6" thickness, with a minimum aged "R" Value of 15.0, installed in two layers with staggered seams as noted on plans, (total R-30.0) when tested per ASTM C1289-11A effective January 1, 2014, of closed cell isocyanurate core with fibrous mat facings, equal to Carlisle InsulBase Polyisocyanurate, Grade 3, (25 psi.) insulation or other F.M. approved insulations, as manufactured by Carlisle, or equal as

approved by the roofing membrane manufacturer. Adjust nailer thickness accordingly. Before ordering, submit approved letter from insulation manufacturer to the Architect that this insulation is approved by the roofing membrane system manufacturer (Carlisle), and will be included in their full systems twenty (20) year warranty.

- B. Tapered Insulation - Shall be Polyisocyanurate tapered board - minimum of 1/2" thick Grade 3, (25 psi). Taper to be minimum 1/8" per foot slope or as noted on plans. Stagger all joints and lay in ashlar pattern. Note tapered insulation to be covered with standard insulation to allow bonding to roof membrane. Before ordering, submit approved letter from insulation manufacturer to Architect that this insulation is approved by the Roofing Membrane System Manufacturer (Carlisle) and will be included in their full systems warranty.

2.05 ACCESSORIES

- A. Prefabricated Flashing Accessories:
 - 1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.
 - 2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.
 - 3. Sealant Pockets: Same material as membrane, with manufacturer's standard accessories, in manufacturer's standard configuration.
 - 4. Sure-Seal Pressure-Sensitive Reinforced Universal Securement Strip (RUSS):
- B. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
 - 1. Length as required for thickness of insulation material and penetration of deck substrate.
- C. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
- D. Sealants: As recommended by membrane manufacturer.
- E. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.
- F. Wood Nailers - Shall be #2 or better lumber, 2"x 6" minimum, weather resistant, pressure treated of sizes as noted or as required. Plywood to be C.D.X. grade and also pressure treated. Nails and anchors shall be hot dipped or hot tumbled, corrosion resistant galvanized steel. Wood nailers at perimeter of roof shall be installed in accordance with F.M. (I-90) guidelines. Existing wood nailers shall be re-anchored in a similar pattern. Galvanized nails or screws shall be installed to penetrate the bottom nailer a minimum of 1-1/4", using a staggered fastening pattern in two rows at 24" on center in each row (12" on center). Fastener pattern density shall be increased within 8' of roof corners in two rows at 12" on center in each row (6" on center). Contractor shall verify that all existing nailers are anchored to decking and/or wall plates similar to the pattern as listed above, or anchored to masonry and structural steel 4'-0" on center, with 1/2" diameter anchor bolts and 5/8" diameter washers.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION, GENERAL

- A. Clean substrate thoroughly prior to roof application.
- B. Surfaces on which the Sure Seal Roofing System is to be applied shall be clean, smooth, dry, free of fins, sharp edges, loose and foreign materials, oil and grease.

- C. Spud off all existing roofing to gypsum decks, as shown on plans and remove from job site in areas where noted. Be careful not to destroy or disturb any electrical conduits on bottom side of deck.
- D. Do not begin work until other work that requires foot or equipment traffic on roof is complete.
- E. Apply manufacturer's recommended vapor retarder or temporary roof before roof installation.
- F. Install wood nailer at the perimeter of the roof and around all roof vents and any similar penetrations. The nailer shall be secured mechanically to the roof deck. The thickness of the nailer shall be as shown, or tapered such that the top of the nailer is flush with the surface to which the membrane is to be applied. Anchors to be of type and spacing's as approved by Carlisle and the Architect.
- G. Before beginning work, a representative of Carlisle SynTec Systems shall examine the roof surfaces in order to insure that existing conditions are acceptable.

3.03 INSTALLATION - GENERAL

- A. Perform work in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. The Architect's drawings and specifications are developed and provided to the Contractor to understand the design intent of the contract. Where these details are in conflict with the standard details, recommendations and specifications of the membrane manufacturer, or affect the guarantee, they shall be modified as required by the Contractor and approved by the Architect at no additional cost to the contract.
- C. All installation and materials used in Sure Seal Universal Roofing Systems shall be as furnished and specified and conforming to all physical properties as manufactured by Carlisle SynTec Systems, a Division of Carlisle Corporation, Carlisle, PA. All details of work shall be coordinated and approved with Carlisle Corporation before starting work.
- D. Do not apply roofing membrane during unsuitable weather.
- E. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- F. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- G. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- H. Coordinate the work with installation of associated counter flashings installed by other sections as the work of this section proceeds.
- I. When substrate preparation is responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.

3.04 INSULATION APPLICATION

- A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
 - 1. Extend vapor retarder under cant strips and blocking to deck edge.
 - 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
- C. Carlisle Sure Seal Bonded Roofing System - Shall be applied over an approved insulation, bonded to the existing roof deck with a Factory Mutual approved system. Install starting from the high point of the roof and working to the low point. Lap all seams shingle fashion in direction of drainage.
- D. Attachment of Insulation:
 - 1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual FM DS 1-29 requirements.

2. Insulation on roof decks shall be installed with standard insulation as specified first and followed by tapered insulation. Adjust lengths of fasteners according to thickness of insulation. Type of screw fastener, fastener pattern, etc., shall be installed as required by insulation mfr., similar to the F.M. I-90 wind up-lift requirements for metal decks.
Contractor shall perform a minimum of (5) anchor pull-out tests on each roof area with the proposed membrane underlayments and fastener to assure compliance with insulation manufacturer's written recommendations. Contractor shall submit written report of pull out tests to the Architect for approval prior to ordering insulation, anchors and roofing. Pull out resistance must meet the membrane manufacturer's requirements.
- E. Lay subsequent layers of insulation with joints staggered minimum 6 inches (152 mm) from joints of preceding layer.
- F. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- G. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch (6.4 mm). Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- H. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches (457 mm).
- I. Do not apply more insulation than can be completely waterproofed in the same day.

3.05 MEMBRANE APPLICATION

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Membrane shall be bonded to the insulation and substrate with the bonding adhesive recommended by the Roofing System manufacturer and shall be installed in strict conformance with the manufacturer's specifications for the "Bonded Roofing System" - Design "A". Bonding Adhesive must be applied to both the membrane and the surface to which it is being bonded.
- D. Adjoining sheets of Membrane are overlapped a minimum of 3" along the length of the membrane (at selvage edged) in preparation for membrane splicing. At end laps (along the width of the sheet), membrane shall be overlapped 1/2" to 1" which will be overlaid with 6" wide Pressure-Sensitive Flashing. Note: all splices shall be overlaid with 6" wide Pressure-Sensitive Flashing for a 20-year warranty.
- E. All field splices of roofing membrane shall be installed using the double sided adhesive tape method with membrane thoroughly cleaned with "splice-wash", as manufactured and specified by Carlisle. Tape width shall be minimum of 6". Coat edge of final seam with lap sealant.
- F. Membrane Splicing with SecureTape:
 1. Prime the splice area with Sure-Seal Primer.
 2. Apply SecureTape to bottom membrane sheet with the edge of the release film along a line marked 1/2" out from the top sheet. Press tape onto sheet using hand pressure, overlapping tape, roll ends a minimum of 1".
 3. Remove the release film and press the top sheet onto the tape using hand pressure. Roll the splice with a 2" wide steel roller.
 4. Install a 6" wide section of Pressure-Sensitive Flashing or Elastoform Flashing over all field splice intersections and seal edges of flashing with Lap Sealant.
 5. The use of Lap Sealant along the entire splice edge is optional, except at tape overlaps.
- G. Membrane Splicing with Splicing Cement:
 1. When using Sure-Seal (black) Membrane, cleaning the splice area is not required unless the membrane has been contaminated with field dirt, adhesive or other residue.
 2. Apply Splicing Cement at a rate of approximately 100 square feet per gallon. Just prior to closing the splice, apply a 1/8" to 1/4" diameter bead of In-Seam Sealant a minimum of 1/2" from the inside edge of the bottom membrane and a minimum of 2" from the lead edge.

3. Roll the top membrane sheet onto the mating surface and roll the splice with a 2" wide steel roller.
 4. After adjoining membrane sheets have been splice together, wait a minimum of 2 hours and, if necessary, clean exposed edge of splice with Splice Cleaner or HP-250 Primer. Apply a 5/16" diameter bead of Lap Sealant and feather to completely cover the splice edge.
- H. Flashing
1. When feasible, flash all walls, curbs, etc., with continuous deck membrane. When the use of continuous membrane is not feasible, a separate piece of Cured EPDM Flashing, or Uncured Membrane may be utilized.
 2. Uncured Elastoform Flashing and Pressure-Sensitive Uncured Flashing shall be limited to overlaying vertical field seams, inside/outside corners, scuppers or other unusually shaped walls or penetrations; where use of Cured EPDM Flashing, EPDM Membrane, Pressure-Sensitive Flashing or Prefabricated accessories (pipe seals, Pourable sealer pockets, corners), is not practical.
 3. When using Pressure-Sensitive Flashing (semi-cured or cured) to overlay metal edging flanges, etc., Sure-Seal Primer must be used to clean the membrane and metal surfaces. Lap Sealant is optional on straight runs of Pressure-Sensitive Flashing and around Pressure-Sensitive Pipe Seals.
 4. Terminate the flashing in accordance with the appropriate FB-9 Termination Detail.
 5. Copings, counter flashing and metal work, not supplied by Carlisle, shall be fastened to prevent metal from pulling free or buckling and sealed to prevent moisture from entering the roofing system or building.
- I. **(for gypsum deck installation)** Insulation on roof decks shall be installed with standard insulation as specified first and followed by second layer insulation. Check to ensure the substrate is dry. FAST Adhesive cannot be applied to a wet or damp surface.
1. Spray apply Sure-Seal FAST Adhesive over the dry substrate, (gypsum decks) at a coverage rate recommended by the manufacturer to allow for full coverage. (ribbons of adhesive greater than 6" on center will not be allowed).
 2. Allow the adhesive to rise up approximately 1/8" and set insulation boards into adhesive. Continue to install boards into the adhesive and after the necessary set up time (will vary based on temperature and amount of catalyst added) walk the boards into the adhesive and using the 30" wide, 100-150 pound weighted steel roller to ensure full embedment. Optimal set up time should be approximately 5 to 10 minutes. One person should be designated to walk/roll in all boards and trim/slit or apply weight as needed to ensure adequate securement.
 3. When multiple layers of insulation are specified or required, spray apply FAST Adhesive over the base layer once fully secured and follow the procedures noted above for attachment of each insulation layer.
- J. At intersections with vertical surfaces:
1. Extend membrane over cant strips and up a minimum of 4 inches (102 mm) onto vertical surfaces.
 2. Provide and install all necessary bar stops as detailed or required to terminate flashings.
 3. Install sealant on top in all exposed areas to adhere to the bar stop and masonry. Shall be as approved by manufacturer (Carlisle Lap Sealant).
- K. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.06 RELATED WORK

- A. Where noted on drawings, or where required in areas of new roofing, re-work all electrical conduits, wiring, gas lines, control wiring, etc.

- B. Provide and install all necessary blocking, clamps, fasteners, fittings, elbows, junction boxes, etc., as required.

3.07 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for general requirements for field quality control and inspection.
- B. Require site attendance of roofing and insulation material manufacturers daily during installation of this work.

3.08 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.
- C. Remove bituminous markings from finished surfaces.
- D. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- E. Repair or replace defaced or damaged finishes caused by work of this section.

3.09 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

**SECTION 077200
ROOF ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof hatches.
- B. Roof Hatch Safety Railing System

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements

1.03 REFERENCE STANDARDS

- A. 29 CFR 1910.23 - Ladders; current edition.
- B. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.
- C. 29 CFR 1926.502 - Fall protection systems criteria and practices; Current Edition.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
 - 1. Non-penetrating Rooftop Supports: Submit design calculations for loadings and spacings.
- D. Warranty Documentation:
 - 1. Submit manufacturer warranty.
 - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for _____. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 ROOF HATCHES AND VENTS

- A. Roof Hatch Manufacturers:
 - 1. Babcock-Davis; Personnel: www.babcockdavis.com/#sle.
 - 2. Bilco Company; Type E (ladder access, 3 ft square, solid cover): www.bilco.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

- B. Safety Railing System: Roof hatch safety rail system mounted directly to curb without penetration of roofing system.
 - 1. Railing Size: As indicated on drawings.
 - 2. Railing: Comply with 29 CFR 1910.23 for ladder safety, with a safety factor of two.
 - 3. Self-Closing Gate: Comply with 29 CFR 1910.29 for safe egress and fall protection through hatch opening.
 - 4. Posts and Rails: Galvanized steel tubing.
 - 5. Gate: Same material as railing; automatic closing with latch.
 - 6. Finish: Manufacturer's standard, factory applied finish.
 - 7. Gate Hinges and Post Guides: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper aluminum.
 - 8. Mounting Brackets: Hot dipped galvanized steel, 1/4 inch (6.4 mm) thick, minimum.
 - 9. Fasteners: Stainless steel, Type 316.
 - 10. Products:
 - a. BILCO Company; Bil-Guard 2.0: www.bilco.com/#sle.
 - b. Babcock-Davis; BSRDAY Roof Hatch Safety Railing: www.babcockdavis.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

END OF SECTION

SECTION 078400 FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements

1.03 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; Current Edition.
- B. FM (AG) - FM Approval Guide; current edition.
- C. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fire Stop Insulation – Shall be “ThermaFiber Fire Safing Insulation” unfaced, flame spread 15, smoke develop 0, as manufactured by Thermafiber Inc, Toledo, Oh. (888-834-2371) Blanket size is 4” thick x 24” x 48”.
- B. Fire Stopping - One part silicone sealant equal to Dow Corning 3-6548 RTV foam, flame spread of 20 per ASTM E-84-76A or Tremco “TREMstop Fyre Sil”.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- D. Fire Ratings: Refer to drawings for required systems and ratings.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Joints deeper than 1/2" shall be built up to a depth of 3/8" below adjacent surfaces with approved compacted filler material prior to applying sealant.
- C. Do not cover installed firestopping until inspected by authorities having jurisdiction.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

**SECTION 079200
JOINT SEALANTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 072700 - Air Barriers: Sealants required in conjunction with air barriers.
- D. Section 078400 - Firestopping: Firestopping sealants.
- E. Section 087100 - Door Hardware: Setting exterior door thresholds in sealant.
- F. Section 088000 - Glazing: Glazing sealants and accessories.
- G. Section 092116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- H. Section 092220 - Non-Structural Metal Framing: Sealing between framing and adjacent construction in acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

- A. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Substrates for which laboratory adhesion and/or compatibility testing is required.
 - 7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 - 8. Sample product warranty.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANTS - GENERAL

- A. Colors: as selected from manufactures complete colors.

2.02 JOINT SEALANTS

- A. General Exterior - One part polyurethane sealant equal to Vulkem 116, or Tremco Dymonic 100.
- B. General interior - Acrylic latex paintable sealant caulking equal to Tremco #834.
- C. Fire Stopping - One part silicone sealant equal to Dow Corning 3-6548 RTV foam, flame spread of 20 per ASTM E-84-76A or Tremco "TREMstop Fyre Sil".
- D. Fixtures/Counters - One part mildew resistant silicone equal to Dow Corning #786.
- E. Compression Joints - one part, butyl #440 Tape, 1/16" or 1/8" by 3/8" or 1/2" wide in Grey or Black color as manufactured by Tremco.
- F. Asphalt Compatible – Sealtight pointing mastic, available in 29 oz. cartridges as manufactured by W.R. Meadows.

2.03 ACCESSORIES

- A. Primer - A quick drying clear primer as recommended by manufacturer shall be used where required.
- B. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- C. Filler Material - Polyurethane foam rod stock, non-gassing, open-cell, equal to Tundra Foam, as manufactured by Industrial Thermo Polymers Limited, 2316 Delaware Avenue, Suite 216, Buffalo, NY 14216 (212-475-2000) and as distributed by Williams Products, Inc., Troy, MI. (248-643-6400). Size shall be such that when compacted, it equals 2/3 of its original width, or as recommended by the sealant manufacturer. Tundra foam rod stock is black (ebony) color, compatible with hot pour and cold applied sealants.
- D. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- E. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.

- C. Joints deeper than 1/2" shall be built up to a depth of 3/8" below adjacent surfaces with approved compacted filler material prior to applying sealant.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Sealant shall be installed in strict conformance with the manufacturer's recommendations. Compounds shall generally be applied by means of a handgun. Use special nozzles as required for hard to apply areas. Exercise extreme care to prevent smearing on adjacent surfaces. A full head of sealant shall be applied into joint under sufficient pressure to fill all voids and joints solidly, drawing nozzle across sealant to leave a slightly concave surface.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Neatly tool joints to slightly concave surface, using tooling agent recommended by sealant manufacturer. Repair any air pockets exposed by tooling. Tool so as to compress material and improve adhesion to surfaces joined. Sealant bead shall be of width/depth and cross section as recommended by manufacturer.
- I. Sealed joints shall not be touched, washed, or otherwise disturbed for 48 hours, to allow sealant to cure.
- J. Final appearance of joint shall be without sags, ripples, globs and waviness. It shall be a straight, uniform sized, continuous flow of material. Work in and blend where one stroke flow ends and other begins.
- K. Joints shall be caulked before painting adjacent work. Do not paint over any sealant unless allowed by manufacturer.
- L. When concrete walks abutt vertical walls and aprons, the expansion joint material is to be held down 1/2" and sealed flush with polyurethane sealant to not pond water.
- M. Caulk all joints as called for on the drawings, or specified herein as required to complete the work including, but not limited to, caulking of the following:
 - 1. At intersections of aluminum work with other materials, etc.
 - 2. Perimeter of louvers and grills at masonry or aluminum.
 - 3. Refer to drawings for other locations.

3.04 FIELD QUALITY CONTROL

- A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.05 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION

**SECTION 081113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire-rated hollow metal doors and frames.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 079200 - Joint Sealants
- D. Section 087100 - Door Hardware.
- E. Section 099000 - Painting and Coating

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2025.
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2018.
- D. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.
- E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2025.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- J. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- K. ASTM C476 - Standard Specification for Grout for Masonry; 2020.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- M. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- N. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- O. ITS (DIR) - Directory of Listed Products; Current Edition.
- P. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- Q. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2024.
- R. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
- S. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- T. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

- U. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- V. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
- W. UL (DIR) - Online Certifications Directory; Current Edition.
- X. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- Y. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements. Provide affidavit that all dimensions/conditions have been field verified.
- D. Samples: Submit two samples of metal, 2 by 2 inches (51 by 51 mm) in size, showing factory finishes, colors, and surface texture.
- E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- F. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.
- B. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steelcraft, an Allegion brand: www.allegion.com/#sle.
- B. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
- C. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
- D. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Manufacturers standard for application indicated.
 - 5. Typical Door Face Sheets: Flush.

6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. Hollow Metal Panels: Same construction, performance, and finish as doors.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Shall be of flush construction. Doors shall be made of 16 Ga. cold-rolled steel, 1-3/4". Doors shall be reinforced, stiffened, sound deadening and insulated with honeycomb type core completely filling inside of doors and laminated to both inside faces of panels. Doors shall have continuous vertical mechanical interlocking joints at lock and hinge edges. Doors shall have beveled (1/8" in 2") hinge and lock edges. Top and bottom steel reinforcing channel shall be spot welded within the doors. Hinge reinforcements shall be 8 Ga. for 1-3/4" doors. Lock reinforcements shall be 16 Ga. and closer reinforcements shall be 8 Ga. for 1-3/4" doors. Doors shall have galvanized reinforcements. Adequate reinforcing shall be provided for all hardware as required for high frequency use and hardware as specified.
- B. Fire Rating: As indicated on Door/Frame Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
- C. Door Finish: Factory primed and field finished.
- D. Fire-Rated Doors:
 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - a. Attach fire rating label to each fire rated unit.
 4. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
 5. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
 6. Door Face Sheets: Flush.
 7. Door Finish: Factory primed and field finished.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Flush Mount Type - Shall be manufactured from 16 Ga. cold-rolled steel, formed to the manufacturer's contour shown on plans with double return back bends. Frame jamb and head connection to be neat flush miter, with head securely locked to top of jamb. Mitered corners shall be welded and ground flush. Frames shall be supplied with factory installed rubber

bumpers, (3) per strike jamb and (2) per head for pair of doors. Frames for 1-3/4" doors shall have 8 Ga. steel hinge reinforcing. Strike reinforcing shall be 16 Ga. and prepared for ANSI 115.1 Universal Strike.

- C. Knock Down (Wrap Around) Type - Shall be manufactured from 16 Ga. cold-rolled steel, wrap around type, formed to the manufacturer's contour shown on plans with double return back bends. Frames shall be knocked down, designed to be securely installed in openings around jambs. Frame jamb and head connection to be neat flush miter, with head securely locked to top of jamb. Mitered corners shall be reinforced with concealed corner clip, to provide a firm interlock of jamb to head. Frames shall be supplied with factory installed rubber bumpers, (3) per strike jamb and (2) per head for pair of doors. Frames for 1-3/4" doors shall have 8 Ga. steel hinge reinforcing. Strike reinforcing shall be 16 Ga. and prepared for ANSI 115.1 Universal Strike.
- D. Fire Rating: As indicated on Door/Frame Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
- E. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- F. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (102 mm) high to fill opening without cutting masonry units.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. All Hollow Metal to be field finished.
- C. Frames at masonry / concrete walls shall have interior coated with Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch (0.4 mm) dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 - 1. Fire-Rated Frames: Comply with fire rating requirements indicated.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 088000, factory installed.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches (102 mm) as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- D. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 087100.
 - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
- F. Coordinate installation of electrical connections to electrical hardware items.
- G. Damaged factory finishes/products are to be replaced (no touch-up of finishes allowed)

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

**SECTION 083100
ACCESS DOORS/PANELS & PASS-THRU CABINETS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall- and ceiling-mounted access units.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 099000 - Painting and Coating

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS

- A. Manufacturer - All doors shall be as manufactured by KARP Maspeth, New York (800-888-4212) or approved equal.
- B. Construction - Shall be 16-gauge frame and trim, 1" wide, with flanged trim for flush mounting with adjacent surfaces. Fire Rated Door to be 20-gauge steel, welded pan type, filled with 2" thick fire-rated insulation. Hinge shall be continuous piano hinge. Latch shall be bolt type, operated by flush key type device (all keyed alike), as selected by Owner. Door shall be operable from inside by single latch release.
- C. Model
 - 1. Fire Rated for wall or ceiling - #KRP-150R
 - a. Fire Rating - All shall be fire rated by U.L. for 1.5 hour "B" label in walls and by Warnoch Hersey for 3 hours in ceiling.
 - 2. Non Fire Rated for wall or ceiling - #DSC-214M
- D. Finish - Factory Painted to be To be White baked enamel with prime coat of rust inhibitive electrostatic powder. If called to be Field Painted with prime coat of rust inhibitive electrostatic powder, baked enamel.
- E. Sizes - As noted on drawings or standard sizes for wall to be 36"H x 24"W and for ceiling to be 36"H x 22"W.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Location - Shall be installed in basic area as shown on drawings and finalized in the field with Owner/Architect before framing in opening. Coordinate with other trades to assure door location and swing will serve function proposed.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Provide templates and rough-in measurements as required.
- C. Begin installation only after substrates have been properly prepared using methods recommended by manufacturer for applicable substrates in accordance with project conditions,

and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.
- D. Anchors - Install and secure into framed in opening per manufacturer's recommendations to achieve same fire rating as door/frame.
- E. Seal with proper sealant all voids, openings and irregularities around entire perimeter of frame against adjacent materials.

3.04 CLEANUP

- A. Remove all stickers, protective coverings and wash as recommended by manufacturer.

3.05 PROTECTION

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

END OF SECTION

**SECTION 087100
DOOR HARDWARE- MPS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hardware for aluminum and hollow metal doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Weatherstripping and gasketing.
- E. Electronic access control system components
- F. Field verification, preparation and modification of existing doors and frames to receive new door hardware

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 079200 - Joint Sealants: Sealants for setting exterior door thresholds.
- D. Section 081113 - Hollow Metal Doors and Frames.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- C. BHMA (CPD) - Certified Products Directory; Current Edition.
- D. BHMA A156.1 - Standard for Butts and Hinges; 2021.
- E. BHMA A156.3 - American National Standard for Exit Devices; 2014.
- F. BHMA A156.4 - Door Closers and Pivots; 2024.
- G. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.
- H. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.
- I. BHMA A156.18 - Standard for Materials and Finishes; 2020.
- J. BHMA A156.19 - Power Assist and Low Energy Power Operated Swinging Doors; 2019.
- K. BHMA A156.20 - Standard for Strap and Tee Hinges, and Hasps; 2021.
- L. BHMA A156.26 - Standard for Continuous Hinges; 2021.
- M. BHMA A156.28 - Standard for Recommended Practices for Mechanical Keying Systems; 2023.
- N. BHMA A156.31 - Electric Strikes and Frame Mounted Actuators; 2024.
- O. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- P. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.
- Q. DHI (H&S) - Sequence and Format for the Hardware Schedule; 1996.
- R. DHI (KSN) - Keying Systems and Nomenclature; 2019.
- S. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.
- T. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.
- U. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- V. ISO 9000 - Quality Management Systems -- Fundamentals and Vocabulary; 2015.
- W. ITS (DIR) - Directory of Listed Products; Current Edition.

- X. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Y. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- Z. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- AA. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2019.
- BB. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- CC. UL (DIR) - Online Certifications Directory; Current Edition.
- DD. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- EE. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- C. Preinstallation Meeting:
 - 1. Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by:
 - a. Affected installers
 - b. Architect
 - c. Installer's Hardware Consultant
 - d. Owner's Hardware Consultant (Allegion)
 - e. Hardware Installer
 - f. Owner's Security Consultant (Habitec)
 - g. Owner's Access Control Consultant (Red Letter)
 - h. Electrical Contractor
 - i. Construction Manager / General Contractor
- D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- E. Electrified Hardware Coordination Conference:
 - 1. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
- F. Keying Requirements Meeting:
 - 1. Schedule meeting at project site prior to Contractor occupancy.
 - 2. Attendance Required:
 - a. Contractor.
 - b. Owner.
 - c. Architect.
 - d. Hardware Installer.
 - e. Owner's Key Representative.
 - f. Owner's Security Consultant.
 - 3. Agenda:
 - a. Establish keying requirements.
 - b. Verify locksets and locking hardware are functionally correct for project requirements.
 - c. Verify that keying and programming complies with project requirements.
 - d. Establish keying submittal schedule and update requirements.

4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
 - a. Access control requirements.
 - b. Key control system requirements.
5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
 1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 2. Include warranties for specified door hardware.
- C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
 1. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
 3. List groups and suffixes in proper sequence.
 4. Provide complete description for each door listed.
 5. Include account of abbreviations and symbols used in schedule.
 6. Indicate complete designations of each item required for each opening, include:
 - a. Door Index: door number, heading number, and Architect's hardware set number.
 - b. Catalog number, Quantity, type, style, function, size, and finish of each hardware item.
 - c. Name and manufacturer of each item.
 - d. Fastenings and other pertinent information.
 - e. Location of each hardware set cross-referenced to indications on Drawings.
 - f. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - g. Mounting locations for hardware.
 - h. Door and frame sizes and materials.
 - i. Degree of door swing and handing.
 - j. Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
 7. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 8. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
- D. Shop Drawings - Electrified Door Hardware: After approval of the hardware schedule, submit riser and wiring diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
 2. Details of interface of electrified door hardware and building safety and security systems.

3. Schematic diagram of systems that interface with electrified door hardware.
4. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
5. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.
6. Risers.
- E. Samples for Verification:
 1. Submit color/finish samples for verification.
- F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
 1. Submit manufacturer's parts lists and templates.
- G. Keying Schedule:
 1. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 2. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 3. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 4. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 5. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 6. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 7. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- H. Installer's qualification statement.
- I. Supplier's qualification statement.
- J. Closeout Submittals:
 1. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 2. Catalog pages for each product.
 3. Factory order acknowledgement numbers (for warranty and service)
 4. Name, address, and phone number of local representative for each manufacturer.
 5. Parts list for each product.
 6. Final approved hardware schedule edited to reflect conditions as installed.
 7. Final keying schedule
 8. Copies of floor plans with keying nomenclature
 9. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 10. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- K. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Lock Cylinders: Ten for each master keyed group.
 3. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.06 QUALITY ASSURANCE

- A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least five years of documented experience.
- D. Supplier Qualifications: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) available to Owner, Architect, and Contractor for consultation and to assist in work of this section.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 - 4. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

1.07 CERTIFICATIONS

- A. Fire-Rated Door Openings:
 - 1. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - 2. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- B. Smoke and Draft Control Door Assemblies:
 - 1. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - 2. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
- C. Electrified Door Hardware
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- D. Accessibility Requirements:
 - 1. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.
- B. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

- C. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- D. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- E. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- F. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- G. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.09 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.10 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
 - 1. Closers: Five years, minimum.
 - 2. Exit Devices: Three years, minimum.
 - 3. Locksets and Cylinders: Three years, minimum.
 - 4. Other Hardware: Two years, minimum.

1.11 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Certain products have been specified for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. Where "Acceptable Manufacturers" is omitted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Provide door hardware products that comply with the following requirements:
 - 1. Applicable provisions of federal, state, and local codes.
 - 2. Accessibility: ADA Standards and ICC A117.1.
 - 3. Applicable provisions of NFPA 101.
 - 4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 - 5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
 - 6. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.
 - a. Air Leakage Rate: Tested in accordance with UL 1784, with air leakage rate not to exceed 3.0 cfm/sf (0.01524 cu m/sec/sq m) of door opening at 0.10 inch (24.9 Pa) of water for both ambient and elevated temperature tests.
 - 7. Listed and certified compliant with specified standards by BHMA (CPD).
 - 8. Auxiliary Hardware: BHMA A156.16.
 - 9. Straps and Tee Hinges: BHMA A156.20.
 - 10. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
 - 11. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
 - 12. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.
- D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
 - 1. See Electrical Division for additional access control system requirements.
 - 2. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
 - 3. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
 - 4. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.
- E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.
- F. Fasteners:
 - 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 - 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to

- match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru bolts are required.
 4. Install hardware with fasteners provided by hardware manufacturer.
 5. Provide fasteners of proper type, size, quantity, that comply with commercially recognized standards for proposed applications.
 - a. Aluminum fasteners are not permitted.
 - b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
 - c. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
 - 1) Self-drilling (Tek) type screws are not permitted.
 - d. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
 6. Provide wall grip inserts for hollow wall construction.
 7. Provide spacers or sex bolts with sleeves for through bolting of hollow metal doors and frames.
 8. Fire-Rated Applications: Comply with NFPA 80.
 - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
 - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.
 9. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.
 - a. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 - b. Use materials which match materials of adjacent modified areas.
 - c. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- G. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.
1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 2. Use materials which match materials of adjacent modified areas.
 3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- H. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- I. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
 2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
 3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
 4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex

connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 CONTINUOUS HINGES

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Stanley
 - b. Roton
 - c. Hager
- B. Requirements:
 - 1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
 - 2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
 - 3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
 - 4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
 - 5. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 - 6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
 - 7. Install hinges with fasteners supplied by manufacturer.
 - 8. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.04 MORTISE LOCKS

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Schlage L9000 series
 - 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 - 1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3 hour fire doors.
 - 2. Indicators: Where specified, provide indicator window measuring a minimum 2 inch x 1/2 inch with 180 degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
 - a. Outside Occupancy Indicator: Provide indicator above cylinder or emergency release for visibility while operating the lock that identifies an occupied/unoccupied status of the lock or latch.
 - 3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
 - 4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
 - 5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
 - 6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

7. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
8. Provide motor based electrified locksets with electrified options as scheduled in the hardware sets and comply with the following requirements:
 - a. Universal input voltage – single chassis accepts 12 or 24V DC to allow for changes in the field without changing lock chassis.
 - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
 - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
 - d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
 - e. Request to Exit Switch (RX) –
 - 1) Modular Design – provide electrified locks capable of using, adding, or changing a modular RX switch without opening the lock case.
 - 2) Monitoring – where scheduled, provide a request to exit (RX) switch that detects rotation of the inside lever.
 - f. Connections – provide quick-connect Molex system standard.
9. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
 - a. Lever Design: Schlage 03A

2.05 EXIT DEVICES

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. Von Duprin 98/35A series
 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
 2. Cylinders: Refer to “KEYING” article, herein.
 3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
 4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
 5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
 6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
 7. Provide flush end caps for exit devices.
 8. Provide exit devices with manufacturer’s approved strikes.
 9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
 10. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
 11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
 12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.

13. Provide electrified options as scheduled.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.06 ELECTRIC STRIKES

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. Von Duprin 6000 Series
 2. Acceptable Manufacturers and Products:
 - a. Folger Adam 300 Series
 - b. HES 1006 Series
- B. Requirements:
 1. Provide electric strikes designed for use with type of locks shown at each opening.
 2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
 3. Where required, provide electric strikes UL Listed for fire doors and frames.
 4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.07 ACCESS CONTROLS

- A. Full Size Proximity Card Reader Manufacturer's and Products
 1. Scheduled Manufacturer and Product:
 - a. HID 5365EKP00
 2. Acceptable Manufacturers and Products:
 - a. None
- B. Half Size Proximity Card Reader Manufacturer's and Products
 1. Scheduled Manufacturer and Product:
 - a. HID 6005BK00
 2. Acceptable Manufacturers and Products:
 - a. None
- C. Controller Board Manufacturer's and Products
 1. Scheduled Manufacturer and Product:
 - a. MERCURY LP1501
 2. Acceptable Manufacturers and Products:
 - a. None
- D. Requirements:
 1. **Owner's Access Control Representative: Red Letter, 4598 Meridian Rd., Addison, MI 49220, (888) 564-5488**
Brad Marowelli - (517)403-9211, brad@redletter.biz
Kyle Shuart - (517)448-0098, kyle@redletter.biz
 2. Provide in price:
 - a. Proximity Card Readers, Controller Boards, wiring harnesses, door contacts, and interface box all provided and installed for a complete system by Owner's Access Control Representative. All wiring pathways to be prepped and installed by the electrical contractor.

2.08 POWER SUPPLIES

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. Schlage/Von Duprin PS900 Series
 2. Acceptable Manufacturers and Products:
 - a. Dynalock 5000 series
 - b. Securitron BPS series

c. Security Door Controls 600 series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
 - a. 12/24 VDC Output, field selectable.
 - b. Class 2 Rated power limited output.
 - c. Universal 120-240 VAC input.
 - d. Low voltage DC, regulated and filtered.
 - e. Polarized connector for distribution boards.
 - f. Fused primary input.
 - g. AC input and DC output monitoring circuit w/LED indicators.
 - h. Cover mounted AC Input indication.
 - i. Tested and certified to meet UL294.
 - j. NEMA 1 enclosure.
 - k. Hinged cover w/lock down screws.
 - l. High voltage protective cover.

2.09 CYLINDERS

A. Existing Key System

1. Manufacturers:
 - a. Scheduled Manufacturer and Product:
 - 1) Best
 - b. Acceptable Manufacturers and Products:
 - 1) No Substitute
2. Requirements:
 - a. **Owner's Key Representative: The Enrico Group, 870 Kensington Ct., Brighton, MI 48119. Attn: Colette Ortiz; Office (248)635-6517; Cell (248)854-6767; <https://www.theenricogroup.com/>**
 - b. Provide in price, cylinders/cores provided and keyed by Owner's Key Representative.

B. Construction Keying:

1. Replaceable Construction Cores.
 - a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 1) 3 construction control keys
 - 2) 12 construction change (day) keys.
 - b. Contractor will replace temporary construction cores with permanent cores.

2.10 KEYING

A. Scheduled System:

1. Existing Best system:
 - a. Provide cylinders/cores keyed into Owner's existing Best keying system managed by Owner's key Representative, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

2.11 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 4010/4110/4020 series

2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
 2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
 3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 11/16 inch (17 mm) diameter double heat-treated pinion journal.
 4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
 5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
 6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
 7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
 8. Pressure Relief Valve (PRV) Technology: Not permitted.
 9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
 10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.12 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. LCN 4600 series
 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 1. Provide low energy automatic operator units with hydraulic closer complying with ANSI/BHMA A156.19.
 2. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
 3. Provide units with conventional door closer opening and closing forces unless power operator motor is activated. Provide door closer assembly with adjustable spring size, back-check, and opening and closing speed adjustment valves to control door
 4. Provide units with on/off switch for manual operation, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay.
 5. Provide drop plates, brackets, and adapters for arms as required for details.
 6. Provide hard-wired actuator switches and receivers for operation as specified.
 7. Provide weather-resistant actuators at exterior applications.
 8. Provide key switches with LED's, recommended and approved by manufacturer of automatic operator as required for function described in operation description of hardware group below. Cylinders: Refer to "KEYING" article, herein.
 9. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence

operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.

10. Provide units with vestibule inputs that allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.13 DOOR TRIM

- A. Manufacturers:
 1. Scheduled Manufacturer: Ives.
 2. Acceptable Manufacturers: Burns, Rockwood.
- B. Requirements:
 1. Provide push plates, push bars, pull plates, and pulls with diameter and length as scheduled.

2.14 PROTECTION PLATES

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Ives
 2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco
 - c. Rockwood
- B. Requirements:
 1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
 2. Size plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
 3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.15 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

- A. Manufacturers:
 1. Scheduled Manufacturers:
 - a. Glynn-Johnson
 2. Acceptable Manufacturers:
 - a. Rixson, ABH
- B. Requirements:
 1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
 2. Provide friction type at doors without closer and positive type at doors with closer.

2.16 DOOR STOPS AND HOLDERS

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Ives
 2. Acceptable Manufacturers:
 - a. Trimco
 - b. Burns
 - c. Rockwood
- B. Provide door stops at each door leaf:
 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button or thumbturn.
 2. Where a wall stop cannot be used, provide universal floor stops.
 3. Where wall or floor stop cannot be used, provide overhead stop.

4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.17 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Zero International
 2. Acceptable Manufacturers:
 - a. National Guard
 - b. Reese
 - c. Legacy
 - d. Pemko
- B. Requirements:
 1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
 2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
 4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.18 MAGNETIC HOLDERS

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. LCN
 2. Acceptable Manufacturers:
 - a. Rixson
 - b. Sargent
- B. Requirements:
 1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.19 DOOR POSITION SWITCHES

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Schlage
 2. Acceptable Manufacturers:
 - a. GE-Interlogix
 - b. Sargent
- B. Requirements:
 1. Provide recessed or surface mounted type door position switches as specified.
 2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.20 FINISHES

- A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
 1. Primary Finish: 652; satin chromium plated over nickel, with steel base material (formar US equivalent US26D); BHMA A156.18.

2. Secondary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
3. Exceptions:
 - a. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.

2.21 SECURITY CONTROLS

- A. Owner's Security Control Consultant
 1. **Habitec Security, 1545 Timberwolf Dr., Holland, OH, 43528; habitecsecurity.com; (419)346-5505**
 - a. **John Smythe - Owner, CEO, (888)422-4832, jrsmlythe@habitecsecurity.com**
 - b. **Todd Mengel - Senior Operations Manager, (419)534-4606, tmengel@habitecsecurity.com**
 - c. **Eric Frankforther - Operations Manager, (419)537-5136, efrankforther@Habitecsecurity.com**
 - d. **Jim Bigelow - Director of Sales, (419)-537-4881, JBigelow@habitecsecurity.com**
 2. Provide in price:
 - a. Proximity Card Readers, Controller Boards, wiring harnesses, door contacts, and interface box all provided and installed for a complete system by Owner's Security Control Consultant. All wiring pathways to be prepped and installed by the electrical contractor.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
- B. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- C. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- D. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- E. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Where on-site modification of doors and frames is required:
 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
 2. Field modify and prepare existing doors and frames for new hardware being installed.
 3. When modifications are exposed to view, use concealed fasteners, when possible.
 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

- A. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- B. Install hardware for smoke and draft control doors in accordance with NFPA 105.
- C. Use templates provided by hardware item manufacturer.
- D. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- E. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- F. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- G. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- H. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- I. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- J. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.
- K. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
- L. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Line levers and roses with lead. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.
- M. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Connections to panel interface modules, controllers, and gateways.
 - 6. Testing and labeling wires with Architect's opening number.
- N. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- O. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- P. Closer/holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

- Q. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- R. Thresholds: Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.
- S. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- T. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- U. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- V. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.
- B. Provide Architectural Hardware Consultant (AHC) **Allegion (Mark Lucas, Architectural Services Consultant - mark.lucas@allegion.com; Phone: 248-496-7100)** to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified, prepare inspection reports, and issue inspection reports.
 - 1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.
 - 2. Representative will inspect fire rated doors and state in report whether installed work complies with NFPA 80.
- C. Provide functional testing and inspection of fire door assemblies by a qualified person in accordance with NFPA 80.
 - 1. Schedule fire door assembly inspection within 90 days of Substantial Completion of the Project.
 - 2. Submit a signed, written final report as specified in Paragraph 1.03.E.1.
 - 3. Correct all deficiencies and schedule a reinspection of fire door assemblies noted as deficient on the inspection report.
 - 4. Inspector to reinspect fire door assemblies after repairs are made.
- D. Provide inspection of required egress door assemblies by a qualified person in accordance with NFPA 101.
 - 1. Schedule egress door assembly inspection within 90 days of Substantial Completion of the Project for the required openings.
 - 2. Submit a signed, written final report as specified in Paragraph 1.03.E.2.
 - 3. Correct all deficiencies and schedule a reinspection of egress door assemblies noted as deficient on the inspection report.
 - 4. Inspector to reinspect required egress door assemblies after repairs are made.

3.05 ADJUSTING

- A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.
- B. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Adjust Hardware for smooth operation.
 - 2. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
 4. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 5. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- C. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.06 CLEANING

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Clean operating items per manufacturer's instructions to restore proper function and finish.
- D. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.07 PROTECTION

- A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage hardware or finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.08 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to 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.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

HOLLYWOOD ELEMENTARY SCHOOL

Hardware Group No. 01

For use on Door #(s):
122A

Provide each COM door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-98-L-NL-F-17	626	VON
1	EA	RIM CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)	626	
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-4RL (COORDINATE POWER REQ'S W/HABITEC; FURNISHED BY RED LETTER)	LGR	SCE
1	EA	CARD READER	(SPECIFIED & FURNISHED BY RED LETTER)		B/O

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY RETRACT LATCH AND ALLOW ENTRY. FREE EGRESS AT ALL TIMES.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.

Hardware Group No. 02

For use on Door #(s):

122B					

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
	EA	BALANCE OF EXISTING HARDWARE	TO REMAIN		B/O
1	EA	PANIC HARDWARE	9875-NL	626	VON
1	EA	RIM CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)	626	
1	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN

CONTRACTOR AND SUPPLIER TO VERIFY EXISTING CONDITIONS PRIOR TO ORDERING/INSTALLING MATERIAL. SUPPLY ALL NECESSARY PLATES, REINFORCEMENTS AND FASTENERS, COMPATIBLE WITH EXISTING CONDITIONS FOR PROPER MOUNTING OF NEW OPENING HARDWARE.

ORCHARD CENTER HIGH SCHOOL

Hardware Group No. 01

132					

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-98-L-NL-F-06	626	VON
1	EA	RIM CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)	626	
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33/WS33X	626	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

1	EA	POWER SUPPLY	PS902 900-4RL (COORDINATE POWER REQ'S W/HABITEC; FURNISHED BY RED LETTER)	LGR	SCE
1	EA	CARD READER	(SPECIFIED & FURNISHED BY RED LETTER)		B/O

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY RETRACT LATCH AND ALLOW ENTRY. FREE EGRESS AT ALL TIMES.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.

END OF SECTION

**SECTION 092116
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Gypsum wallboard (regular).
- B. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 072100 - Thermal Insulation: Acoustic insulation.
- D. Section 078400 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
- E. Section 079200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- F. Section 092220 - Non-Structural Metal Framing.

1.03 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- F. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- G. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- H. GA-216 - Application and Finishing of Gypsum Panel Products; 2018.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- D. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

PART 2 PRODUCTS

2.01 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 - 2. USG Corporation: www.usg.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 3. Thickness:
 - a. Vertical surfaces: Min. 5/8" thick unless called out otherwise.
 - b. Ceilings: min. 5/8" thick unless called out otherwise. Overlaying existing board where sufficient support may be 1/2" min.

2.02 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: See Section 072100.
- B. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise. Control joints to be zinc #093.
- C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Paper Tape: 2 inch (50 mm) wide, high strength creased paper tape for joints and corners.
 - 2. Mud/Joint compound to be conventional medium weight. No lightweight materials are acceptable.
- D. Adhesive shall be panel type adhesive, water resistant, weatherproof, non-toxic, non-flammable, non-combustible equal to "PL Premium Adhesive" and as approved by the drywall manufacturer.
- E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
- F. Anchorage to Substrate: Tie wire, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 BOARD INSTALLATION

- A. Install gypsum board as shown on the drawings and comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations. Installation shall be a 1st class job. Install with adhesive and screws. Hold drywall up from floor 1/2"±.
- B. All ends and edges of board shall occur over backing member and/or be installed to meet a U.L. one hour or two hour fire rating as detailed. Seal all gaps against adjacent existing materials (head, sill, etc.) with sealant - see Division #7.
- C. Ceilings are not to be anchored to any wood roof trusses any closer than 18" to any interior non-bearing wall. Drywall shall be clipped into plates as provided and installed by others.
- D. In areas of drywall ceilings with drywall soffits, drywall ceiling shall be installed first, followed by framing and ductwork. Exterior of soffit then to be covered with drywall. All shall be to maintain a 1-hour fire envelope at ceiling line.
- E. Install full height "J" trim on drywall edges where interior walls abut other materials.
- F. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- G. On full height walls, floor to floor/roof deck above, install drywall to form a minimum one hour envelope unless noted otherwise. Patch drywall and compound around all structural members, ductwork/fire dampers. Continue any expansion joint, full height floor to deck. Fill gaps

between wall and deck, joists, and other obstructions with fire safing insulation (see other division).

- H. Refer to related mechanical/electrical drawings and drywall around all ductwork, grilles, openings, sleeves, etc. that occur in the drywall work either in exposed or unexposed locations. Seal drywall work tight to the passage of air. Special areas subject to movement are to be sealed with sealant or fire safing insulation/materials.

3.03 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Install all control joints and expansion joints consistent with lines of building spaces and in locations as required, recommended manufacturer and as noted and field verified in the field with Architect. Adjust location, provide proper ceiling/wall backing and add additional joints as required to insure proper movement of wall/ceiling without cracking.
- B. Corner Beads: Install at external corners, using longest practical lengths.

3.04 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- B. Finish gypsum board in accordance with highest level/quality level 5 or better as defined in ASTM C840, except in the following locations:
 - 1. Level 3: Walls to receive textured wall finish.
 - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
 - 4. Level 0: Temporary partitions.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Apply a uniform thin layer of joint compound to all joints and angles to be reinforced. Immediately apply joint tape centered over joint and seated into compound. Sufficient compound (approximately 1/64" to 1/32") must remain under the tape to provide proper bond. Follow immediately with a thin skim coat to embed tape, but not to function as a second coat. The tape or embedding coat must be thoroughly dry prior to application of second coat.
 - 2. Apply second coat of joint compound over embedded coat fill panel taper flush with surface; cover tape and feather out at least 3" beyond the first coat. On joints with no taper, cover tape and feather out at least 4" on either side of the tape. Allow second coat to dry thoroughly prior to application of finish coat.
 - 3. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
 - 4. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
 - 5. Taping, filling, and sanding are not required at base layer of double-layer applications.
 - 6. On all exposed drywall, whether scheduled for paint or finishing or not, install a finish coat of compound evenly over and extend at least 2" beyond second coat on all joints and feather to a smooth uniform finish. This step is not necessary for drywall above suspended ceilings. Do not allow finish joint to protrude beyond the plane of the surface. Where necessary, sand lightly between coats and the final application of compound to provide a smooth surface, ready for decoration. When sanding, take care not to roughen face paper. Globbs, misses gaps, etc., will not be accepted. The taping and spackling of drywall in un-exposed areas (above acoustical suspended ceilings) shall be finished the same as exposed areas, excluding the skim coat.
- D. After all irregularities have been eliminated and the joint treatment surfaces sanded, apply a thin skim coat of joint compound to the entire surface of the board that is exposed to the occupied space that is scheduled for paint or finishing (above ceilings excluded). Caution should be taken to eliminate laps or tool marks in the skim coating operation. The entire

surface shall be lightly sanded as required to assure a smooth and even surface. An optional method is to install a prime coat of "Sheetrock First Coat", as manufactured by USG.

- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.05 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

**SECTION 092220
NON-STRUCTURAL METAL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 092116 - Gypsum Board Assemblies: Metal studs for gypsum board partition framing.

1.03 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2018).
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- F. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
 - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
 - 1. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 2. Marino: www.marinoware.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 10 psf (L/120 at 480 Pa).
 - 1. Interior Studs: C-shaped with knurled or embossed faces. Min. 22 Ga., 3-5/8 x 1-1/4". For abuse resistant installation (Defined as areas called for hi-impact drywall) studs and track to be 20 Ga.
 - 2. Runners: U shaped, sized to match studs. Min. 22 Ga., 3-5/8" x 1-1/4".
 - 3. Ceiling Channels: C shaped min. 3-5/8" x 2.
- B. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- C. Area Separation Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with specified performance requirements.
- D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot-dipped galvanized coating.
 - 3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
 - 4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
- E. Non-Loadbearing Framing Accessories:
 - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 - 2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
 - 3. Metal bridging shall be galvanized, 16 Ga., 1-1/2" cold-rolled channels at 4'-0" o.c. from finished floor.
 - 4. Fasteners: ASTM C1002 self-piercing tapping screws.
 - 5. Acoustic Insulation: As specified in Section 072100.
 - 6. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic.

2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.
- C. Fit and assemble in largest practical sections for delivery to site, ready for installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

- A. Comply with requirements of ASTM C754.
- B. Walls to be installed to meet a U.L. (1) hour rating, or (2) hour fire rating as detailed.
- C. See plans for wall heights – some to be full height from floor to floor/roof, floor to ceiling, floor to above ceiling, etc. All to be floor to roof unless noted otherwise. Maintain gap to deck (1/2"+) to allow deck movement. Gap remaining to be filled with fire safing insulation (see other division).
- D. Extend partition framing to structure where indicated and to ceiling in other locations.

- E. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- F. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- G. Align and secure top and bottom runners at 24 inches (600 mm) on center.
- H. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- I. Studs: Space studs at 16 inches on center (at 406 mm on center) or as indicated an/or as required to meet standard.
- J. Align stud web openings horizontally.
- K. All new walls/furring to be framed around ductwork penetrations. See drawings for location and sizes of ductwork.
- L. Secure studs to tracks using fastener method. Do not weld.
- M. Stud splicing is not permissible.
- N. Fabricate corners using a minimum of three studs.
- O. Install double studs at wall openings, door and window jambs, not more than 2 inches (50 mm) from each side of openings.
- P. Brace stud framing system rigid. Anchor all walls properly to existing walls and structure with diagonal bracing, cross members, etc., for proper support.
- Q. Coordinate erection of studs with requirements of door frames; install supports and attachments.
- R. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- S. Blocking: Use wood blocking secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.
- T. Furr out all walls where noted, installing members at 16" on center as required. Anchor to wall and to top and bottom runner channels.

3.03 CEILING AND SOFFIT FRAMING

- A. Comply with requirements of ASTM C754.
- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- E. Space main carrying channels at maximum 72 inch (1 800 mm) on center, and not more than 6 inches (150 mm) from wall surfaces. Lap splice securely.
- F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- G. Place furring channels perpendicular to carrying channels, not more than 2 inches (50 mm) from perimeter walls, and rigidly secure. Lap splices securely.
- H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches (600 mm) past each opening.
- I. Laterally brace suspension system.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet (3 mm in 3 m).

END OF SECTION

**SECTION 096500
RESILIENT FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements
- C. Section 030100 - Maintenance of Concrete Cleaning, repairing spalling, and leveling for floor tolerances.

1.03 REFERENCE STANDARDS

- A. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2018).
- B. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.
- C. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Materials: Quantity equivalent to 5 percent of each type and color.
 - 3. Extra Wall Base Materials: Quantity equivalent to 5 percent of each type and color.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum five years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store all materials off of the floor in an acclimatized, weather-tight space.
- B. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- C. Protect roll materials from damage by storing on end.
- D. Do not double stack pallets.

1.07 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.01 TILE FLOORING

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
 - 1. To be "Standard Excelon", as manufactured by Armstrong Cork Co., or equal by Kentile, Azrock, Congoleum, or approved equal.
 - 2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
 - 3. Size: 12 by 12 inch (305 by 305 mm).
 - 4. Thickness: 0.125 inch (3.2 mm).
 - 5. Pattern: Lay all marbleized tile with veining running in same direction or as noted on drawings.
 - 6. Color: As indicated on drawings or where not indicated, to be selected by Architect from manufacturer's full range. Each room may contain multiple colors and may be different from other rooms.

2.02 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; style as scheduled.
 - 1. Manufacturers:
 - a. Burke Flooring: www.burkeflooring.com/#sle.
 - b. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
 - c. Roppe Corporation: www.roppe.com/#sle.
 - d. Armstrong; <http://www.armstrong.com/>
 - e. Substitutions: See Section 016000 - Product Requirements.
 - 2. Height: 4 inch (100 mm).
 - 3. Thickness: 0.125 inch (3.2 mm).
 - 4. Finish: Satin.
 - 5. Profile: Straight base for Carpet. Cove base for all other flooring types.
 - 6. Color: As indicated on drawings. May have up to (2) colors throughout ea. building.

2.03 ACCESSORIES

- A. Transitions assumed to be resilient mercer strip, by Roppe, Burke Flooring or approved equal in color as selected by architect, unless indicated on drawings.
- B. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- C. Tile: Primers, Adhesives, and Seam Sealers shall be as manufactured by, or as recommended by the Tile Manufacturer.
- D. Resilient Base: Adhesive shall be as manufactured by, or as recommended by the base Manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Ensure substrate meets the requirements of ASTM F710.
- B. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).
- C. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- D. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- E. Prohibit traffic until filler is fully cured.
- F. Clean substrate. Substrates must be free of visible water or moisture, dust, sealers, paint, sweeping compounds, curing compounds, residual adhesives and adhesive removers, concrete hardeners or densifiers, solvents, wax, oil, grease, asphalt, visible alkaline salts or excessive efflorescence, mold, mildew and any other extraneous coating, film, material or foreign matter.
- G. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - TILE FLOORING

- A. Tile shall be laid from contents of at least two different containers and/or sorted, so that marbleizing and color will be uniform and not spotty. Lay all marbleized tile with veining running in same direction. Obtain Owner/Architect approval prior to installation.
- B. At door openings or junctures with other materials, or where thresholds of other materials are not specified, install reducer strip full width of juncture, #633, as manufactured by Mercer.

3.05 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints or at corner returns.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.
- C. Scribe and fit to door frames and other interruptions.
- D. Install base on all walls, unless noted otherwise, for a uniform appearance.
- E.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

**SECTION 099000
PAINTING AND COATING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Interior painting and coating systems.
- C. Exterior painting and coating systems.
- D. Scope:
 - 1. This Contractor shall paint all exterior and interior building materials as required for a finished installation or as noted on drawings.
 - 2. Finish surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including but not limited to the following: .
 - a. Interior walls and exposed drywall ceilings.
 - b. Exposed CMU walls.
 - c. Interior concrete floors.
 - d. Interior steel doors and frames and window frames.
 - e. Roof sanitary vents, furnace flue/air intake, non-shingle roof elements, mechanical vents/louvers in walls, etc.
 - f. Exposed gas piping (on roof and elsewhere).
 - g. Interior and Exterior Electrical items not factory finished or as called out to be painted such as meter, electric disconnect/conduits/meter socket, etc. All new wire mold.
 - h. Electrical / Fire Alarm Replacement and Updates - new device/junction boxes, cover plates, conduits, wire mold. Any surface exposed after work is completed, that was not exposed prior to work.
 - i. Marking and identification of Fire and Smoke barriers, partitions, and walls.
 - j. Miscellaneous items as required for a finished installation.
 - k. Patch Paint - any surface that was not exposed prior to this work and becomes exposed as a result of this work.
 - l. Items as called out in drawings.
 - 3. Patch painting as called out in drawings and as required for a finished appearance.
 - 4. Contractor shall acquaint himself with all divisions of the specifications and drawings, as he shall paint or finish to completion all materials requiring painting or finishing which are left un-finished.

1.02 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements
- B. Section 017000 - Execution and Closeout Requirements

1.03 REFERENCE STANDARDS

- A. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- B. SSPC-SP 2 - Hand Tool Cleaning; 2024.
- C. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- D. SSPC-SP 13 - Surface Preparation of Concrete; 1997 (Reaffirmed 2003).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Product characteristics.
 - 2. Surface preparation instructions and recommendations.
 - 3. Primer requirements and finish specification.

4. Storage and handling requirements and recommendations.
 5. Application methods.
 6. Clean-up information.
- C. Samples: Submit four paper draw down samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
- D. Applicator's qualification statement.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements for additional provisions.
 2. Extra Paint and Finish Materials: 1 gallon (4 L) of each color; from the same product run, store where directed.
 3. Label each container with color in addition to manufacturer's label.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.
- D. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

1.07 FIELD CONDITIONS

- A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.
- B. Follow manufacturer's recommended procedures for producing the best results, including testing substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Products: Subject to compliance with requirements, provide Sherwin-Williams Company (The) products indicated; www.sherwin-williams.com/#sle.
- B. Comparable Products: Products of approved manufacturers will be considered in accordance with 016000 - Product Requirements, and the following:
1. Other Acceptable Manufacturers:

2.02 PAINTINGS AND COATINGS

- A. General:
1. Provide factory-mixed coatings unless otherwise indicated.
 2. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application.
 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.
- B. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.03 PAINT SYSTEMS - INTERIOR

- A. Interior Drywall – Paint Latex
- 1 Coat: SW ProMar 200 Zero VOC Interior Latex Primer, B28 Series (4 mil wet, 1.0 mil dry)

2 Coats: SW ProMar 200 Zero VOC Interior Latex Eg-Shel, B20 Series (4 mil wet, 1.5 mil dry)

B. Interior Wood - Paint

1 Coat: SW Prep Premium Wall and Wood Interior Latex Primer, B28 Series (4 mil wet, 1.6 mil dry)

2 Coats: SW ProMar 200 Zero VOC Interior Latex Eg-Shel, B20 Series (4 mil wet, 1.5 mil dry)

C. Interior Concrete Block/Brick - Paint

1 Coat: SW Pro Industrial Heavy-Duty Block Filler, B42 Series (16.0-21.0 mil wet, 8.0-10.5 mil dry)

2 Coats: SW ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31 Series (4 mil wet, 1.5 mil dry)

D. Interior Ferrous Metal – Paint

1 Coat: SW Pro Industrial Pro Cryl Universal Primer, B66 Series (5-10 mil wet, 1.8-3.6 mil dry)

2 Coats: SW Pro Industrial Acrylic Semi-Gloss, B66 Series (6-12 mil wet, 2.1-4.2 mil dry)

E. Interior Galvanized Metal – Paint

1 Coat: SW Pro Industrial Pro Cryl Universal Primer, B66 Series (5-10 mil wet, 1.8-3.6 mil dry)

2 Coats: SW Pro Industrial Acrylic Semi-Gloss, B66 Series (6-12 mil wet, 2.1-4.2 mil dry)

F. Interior Concrete Floor – Non Slip Epoxy Coating

2 Coats EUCOPOXY TUFCOAT (2 Part Epoxy Clear or Colored Semi-Gloss Coating) Shall be as manufactured by the Euclid Chemical Co., Cleveland, OH. Color to be clear or solid color as selected. Coating shall be installed after all major work is complete and when floor is completely dry. Thoroughly clean concrete floor of all grease, oil, dirt, etc. per manufacturer directions, for proper adherence and so once sealed, a uniform appearance is achieved. Refer to manufacturer's recommendations for cleaning and if floor is acid cleaned, properly neutralize per manufacturer's recommendations before installing sealer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

- A. General - Before painting, remove hardware, accessories, plates, lighting fixtures, fire alarm devices, and other similar items, or provide ample protection of such items. Remove any clear covers or other items where the painted surface can be seen at completion. Upon completion of each space, replace above items. Use only skilled mechanics for removing and connection of above items.
- B. Clean surfaces thoroughly and correct defects prior to application.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- D. Remove mildew from impervious surfaces by scrubbing with solution of water and bleach. Rinse with clean water and allow surface to dry.
- E. All hairline cracks, splits, gouges, scratches and alligatored surfaces shall be spackled with Durabond 90, following manufacturer's recommendations. Prime these areas with a heavy-

- duty primer similar to Sherwin Williams Prep Rite High Build Latex Primer, B28W601 (1-4 Mills Dry).
- F. Roughen up and clean all surfaces as required by manufacturer for proper bonding of product used to the material/surface being prepped.
 - G. Concrete:
 - 1. Remove release agents, curing compounds, efflorescence, and chalk.
 - 2. Fill bug holes, air pockets, and other voids with cement patching compound.
 - 3. Prepare concrete according to SSPC-SP 13.
 - H. Masonry: Remove efflorescence and chalk.
 - I. Gypsum Board: Fill minor defects with filler compound; sand smooth and remove dust prior to painting.
 - J. Plaster: Fill hairline cracks, small holes, and imperfections with patching plaster. Make smooth and flush with adjacent surfaces. Treat textured, soft, porous, or powdery surfaces in accordance with manufacturer's instructions.
 - K. Concrete Floors and Traffic Surfaces: Prepare concrete according to SSPC-SP 13.
 - L. Aluminum: Remove surface contamination and oil; wash with solvent according to SSPC-SP 1.
 - M. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Prepare surface according to SSPC-SP 2.
 - N. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Prime bare steel surfaces.
 - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended by paint manufacturer and blast cleaning according to SSPC-SP 6. Protect from corrosion until coated.
 - O. Wood: Remove dust, grit, and foreign matter. Scrape, sand, and spot prime knots and pitch streaks. Fill nail holes and imperfections with wood filler and sand smooth.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. All paint shall be installed in strict conformance with manufacturer's specifications. Surface to be painted shall be clean, dry, smooth and adequately protected from weather. Temperature shall be above 50 degrees F.
- C. Finished work shall be uniform, of approved color, smooth and free from runs, sags, defective brushing, clogging, or excessive flooding.
- D. Small cracks, holes and other imperfections in masonry surfaces, which show up after primer-sealer has been applied to the surface shall be filled with an approved spackling compound before application of second coat.
- E. Paint or finish all work specified herein and all work customarily painted for appearance or protection, as well as other specified items of work scheduled to be painted in room finish schedule.
- F. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness.
- G. Regardless of number of coats specified, apply additional coats until complete uniform color, hide, and sheen is achieved.
- H. Fire Alarm / PA System Replacement - any surface that is exposed after work is completed, that was not exposed prior to work, is to be patch painted to color blend into the primary

adjacent surface. All wire mold or exposed conduit to be painted to match surface it is mounted to. New and existing cover plates and device/junction boxes exposed to view as part of this work to be painted the color of surface mounted to.

- I. Marking and identification of Fire and Smoke barriers, partitions, and walls:
 - 1. Where there is an accessible concealed floor, floor-ceiling or attic space, fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with stenciling in the concealed space. Such identification shall:
 - a. Be located within 15 feet (4572 mm) of the end of each wall and at intervals not exceeding 30 feet (9144 mm) measured horizontally along the wall or partition.
 - b. Include lettering not less than 3 inches (76 mm) in height with a minimum 3/8-inch (9.5 mm) stroke in a contrasting color incorporating the suggested wording, "FIRE AND/OR SMOKE BARRIER—PROTECT ALL OPENINGS," or other wording.
 - 2. Included are both sides of all barriers, partitions, and walls within the contract limits and/or as indicated on the drawings.
- J. All patch painting shall be done in neat logical configurations, stopping at logical break points, such as inside or outside corners, at change of materials, or as directed by the Owner/Architect.

3.04 PRIMING

- A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Primers specified in painting schedules may be omitted on items factory primed or factory finished items if acceptable to top coat manufacturers.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

- A. Protect finished coatings from damage until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

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**SECTION 220411
BASIC PLUMBING SYSTEM REQUIREMENTS**

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other sections of Division 22.

1.02 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installation. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01.

1.03 SUBMITTAL PROCEDURES: REFER TO SECTION 22 04 12 "SUBMITTAL PROCEDURES."

1.04 MAINTENANCE MANUALS

- A. Prepare operation and maintenance manual; include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.

1.05 COORDINATION DRAWINGS

- A. Contractor shall prepare coordination drawings for boiler room piping, equipment, routing of main piping in tunnels and pipe risers as required. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the work. Include the following:
 - 1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - 2. Clearances for installing and maintaining insulation.
 - 3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - 4. Equipment and accessory service connections and support details.
 - 5. Exterior wall, roof and foundation penetrations.
 - 6. Fire-rated wall and floor penetrations.
 - 7. Sizes and location of required concrete pads and bases.
 - 8. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - 9. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

10. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.
- B. RECORD (AS-BUILT) DOCUMENTS
- C. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:
 1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Section 220553 "Identification for Plumbing Piping & Equipment." Indicate actual inverts and horizontal locations of underground piping.
 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 4. Contract Modifications, actual equipment and materials installed.

1.06 CONTRACT DRAWINGS

- A. In general, drawings are schematic in nature and are intended as a guide to the Contractor, but do not necessarily show all details, offsets, etc. All drawings are to be thoroughly inspected.
- B. The Contractor's work shall conform to the information contained in this Specification and/or as indicated in the latest revision of the drawings referred to therein. The Contractor shall consult with the Engineer regarding all questions on which he may be in doubt before proceeding with fabrication of parts affected. The Contractor shall prepare all additional detail or field installation drawings necessary at his own expense. The Contractor shall verify all dimensions and conditions indicated on the Engineer's layout drawings and determine if any changes are required in conduits, piping runs, drains, ducts, etc., to avoid interference. Major changes shall not be made without the approval of the Engineer.
- C. While the drawings are to be adhered to as closely as possible, the Contractor has the right to vary the run of conduits, piping and/or ducts during progress of the work as may be found necessary or desirable to avoid interferences. Major revisions shall be verified with the Engineer.

1.07 VERIFICATION

- A. Before running any conduits, ducts, piping, etc., within the building, this Contractor shall field verify all existing conditions and existing in place items. Contractor shall assure himself that they can be installed as contemplated without trapping or interfering with columns, beams, piping, fixtures, etc. Any necessary major deviation shall be referred to the Engineer for adjustment before lines are run, at no increase in contract price.
- B. Of necessity, openings, supporting steel, field-built curbs, electrical data, space requirements, etc., were designed around specific parameters. When the Contractor determines the make of equipment to be provided for the job, it shall be his responsibility to verify and coordinate unit dimensions with all other sub-contractors on the job. It shall also become the Contractor's responsibility to change as necessary, through the Engineer, all required dimensions so that openings, supporting steel, curbs, electrical data, etc., will fit the equipment supplied. Any additional cost will be the sole responsibility of this Contractor.

- C. Electrical power, interlock and control diagrams and piping arrangements were designed around one specific manufacturer. If additional wiring, piping controls, etc., are required for other equipment, this Contractor shall include the cost of same in his price.
- D. Dimensions, elevations and relative locations of existing equipment, sewers, pipes, ducts, conduits, etc., in place as shown on the drawings, are taken from as-built and record drawings and are deemed reliable only insofar as general layout is concerned. Such dimensions shall not be used for layout drawings nor detailing of components. The responsibility for checking in place items will be the Contractors. All measurements, the exact determination of relative elevations or locations, the ascertaining of accuracy of all given elevations and dimensions and the obtaining of all necessary additional information to ensure the proper fit and coordination of all conduit equipment, ducts, and piping shall be the responsibility of the Contractor.

1.08 PRODUCT SUBSTITUTIONS

- A. The manufacturers listed in the equipment schedules are included as a basis of design. Submission of alternate manufacturers of similar equipment is subject to engineer approval. Units of equipment, other than those listed as the basis of design, must be proven to be physically acceptable, in addition to meeting all performance and equipment specifications. Liability of non-conformance shall lie with the Contractor/Submitter. Bidders desiring consideration for the use of material, equipment, etc. not named in the Specifications may submit in writing, at least seven (7) days prior to bid opening, the change including the specifications and description to the Architect for review and if approved, the change will be issued in an addendum at least four (4) days prior to the opening of bids.

PART 2 – PRODUCTS

2.01 NOT APPLICABLE

PART 3 – EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.02 PLUMBING INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of plumbing systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate systems, equipment, and materials installation with other building components. Verify all dimensions by field measurements.
 - 2. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for installations.
 - 3. Coordinate the installation of required supporting devices, sleeves and other structural components, as they are constructed.
 - 4. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 6. Install systems, materials, and equipment to conform with approved submittal data. Conform to arrangements indicated by the Contract Documents, recognizing that

portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect/Engineer.

7. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnection, with minimum of interference with other installations. Extend grease fittings to an accessible location. Install access panel or doors where equipment is concealed behind finished surfaces.
8. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
9. Electrical requirements for plumbing equipment shall conform to the data indicated on the plumbing contract documents. Where such information is not included, this contractor shall coordinate the electrical requirements (i.e. voltage, phase, starter requirements, etc.) with those shown on the electrical drawings. If motors or equipment furnished hereunder, require more or larger starters, more or larger branch circuits, additional disconnects, etc., from that indicated on the mechanical drawings or specified herein, this contractor shall reimburse the Electrical Contractor for the cost differential he incurs. It is the responsibility of each contractor furnishing motors, to advise the Electrical Contractor of the exact function of the supplied systems to assure proper operation.

3.03 CUTTING AND PATCHING:

- A. Perform cutting, fittings, and patching of mechanical equipment and materials required to install equipment and materials in existing structure. Cut, remove and legally dispose of components and materials made obsolete by the new work. Protect the structure, furnishings, finishes, and patching. Patch existing finished surfaces and building components using new materials (which match adjacent materials) and utilize experienced installers.

3.04 REMOVALS:

3.05 CONTRACTOR TO PERFORM ALL REMOVALS INDICATED IN CONTRACT

DOCUMENTS. THE OWNER HAS THE OPTION TO RETAIN ALL EQUIPMENT AND/ OR MATERIALS REMOVED. ALL OTHER MATERIALS NOT CLAIMED BY THE OWNER OR REUSED SHALL BE REMOVED FROM THE SITE BY THE MECHANICAL CONTRACTOR.

END OF SECTION

**SECTION 220412
SUBMITTAL PROCEDURES**

PART 1 GENERAL

1.01 SUMMARY

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

1.02 DEFINITIONS

- A. Action Submittals: Written and graphic information that require Architect/Engineer's responsive action.
- B. Informational Submittals: Written and graphic information that do not require Architect/Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.03 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/Engineer and additional time for handling and reviewing submittals required by those corrections.

1.04 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect/Engineer's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will be provided by Architect/Engineer for Contractor's use in preparing submittals. Do not base Submittals on reproductions of the Contract Documents or standard printed data.
 - 1. Architect/Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect/Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. 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. Architect/Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect/Engineer'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 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 14 days for review of each resubmittal.

- D. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Stamp shall include project name, location, specification section, 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.
- 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/Engineer.
 - 3. Include the following information for processing and recording action taken:
 - a. Project name and Date.
 - b. Name of Architect/Engineer.
 - c. Name of Contractor.
 - d. Name of subcontractor.
 - e. Name of supplier.
 - f. Name of manufacturer.
 - g. Number and title of appropriate Specification Section.
 - h. Drawing number and detail references, as appropriate.
 - i. Location(s) where product is to be installed, as appropriate.
 - j. Other necessary identification.
 - 4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect/Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 - 5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect/Engineer will return, without review, submittals received from sources other than Contractor.
- 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.
 - 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect/Engineer.
 - 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect/Engineer, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect/Engineer.
 - 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. Other necessary identification.
 - p. Remarks.
- G. Options: Identify options requiring selection by Architect/Engineer.
- 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 authorization notation from Architect/Engineer's action stamp.
 - 4. Resubmittal Limitation Requirements: The Architect/Engineer will provide time to review the original submittal and ONE resubmittal. If resubmittals are required pursuant to the first resubmittal, the Architect/Engineer's time for these services will be paid by the Contractor. The charges for this time will be back-charged from the Contractor as a change-order through this project's contract. These charges will be based upon the Architect/Engineering standard hourly rates (i.e. Engineer @ \$125.00/hr, etc.).
- 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 authorization notation from Architect/Engineer's action stamp.

PART 2 PRODUCTS

2.01 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements:
- 1. Upload electronic submittals as PDF electronic files directly to Construction Manager's implemented online construction management software platform.
 - 2. Upon successful upload of submittal documents, notify Architect and Engineer in writing via email.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment. Multiple submittals for a single type of equipment are not acceptable. Submittal for a single type of equipment shall be based on one manufacturer throughout project.
- 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:
 - a. Manufacturer's catalog cuts and Manufacturer's product specifications.
 - b. Standard color charts.

- c. Statement of compliance with specified referenced standards.
 - d. Testing by recognized testing agency.
 - e. Application of testing agency labels and seals.
 - f. Notation of coordination requirements.
 - g. 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 in the PDF electronic file format.
- 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.
 - 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 30 by 42 inches.
 - 3. Submit Shop Drawings in the PDF electronic file format.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Submit product schedule in PDF electronic file format.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. 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.
- G. 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.
- H. 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.
- I. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- J. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

- K. 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.
- L. 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.
- M. 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.
- N. 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.
- O. 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.
- P. 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.
- Q. 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.

PART 3 EXECUTION

3.01 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/Engineer.
- B. 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.

3.02 ARCHITECT/ENGINEER'S ACTION

- A. General: Architect/Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action and Informational Submittals: Architect/Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect/Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - 1. Architect/Engineer's Review Status:
 - a. No Exceptions Taken
 - b. Exceptions Taken As Noted

- c. Resubmit
 - d. Rejected
- 2. Action Required of Contractor:
 - a. Process
 - b. Resubmit
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION

**SECTION 220517
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.

1.02 RELATED REQUIREMENTS

- A. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.
- B. Section 220719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Plastic or Metal: Pipe passing through interior walls.
- B. Clearances:
 - 1. Provide allowance for insulated piping.
 - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
 - 3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 to prevent the spread of fire, smoke, and gases.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. Aboveground Piping:
 - a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 - 2. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 to prevent the spread of fire, smoke, and gases.
- E. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.02 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

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**SECTION 220519
METERS AND GAUGES FOR PLUMBING PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges.
- B. Thermometers.

1.02 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2025).
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).

1.03 SUBMITTALS

- A. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.
- B. Project Record Documents: Record actual locations of components and instrumentation.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Pressure Gauges: One of each type and size.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Bourdon Tube for Liquids and Gases:
 - 1. Dial Size and Cover: 4-1/2 inch diameter scale with polycarbonate window.
 - 2. Dial Text and Markings: Black color on white background with scaled psi units.
 - 3. Accuracy: ASME B40.100, adjustable commercial grade (D) with 5 percent of span.
 - 4. Process Connection: Lower-back, 1/4 inch NPT male except where noted.
 - 5. Gauge Wetted Materials: Painted steel case and brass socket rated to match process pressure and temperature range.
- B. Accessories:
 - 1. Gauge Cock: Brass with tee or lever handle for maximum 150 psi.
 - 2. Pressure Snubber (Pulsation Damper): Brass, 1/4 inch NPT male.

2.02 THERMOMETERS

- A. General:
 - 1. Product Compliance: ASTM E1.
 - 2. Lens: Clear glass, except where stated.
 - 3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
 - 4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.
- B. Thermometers - Adjustable Angle: 7 inch v-shape aluminum case with clear glass window scale, 6 inch NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions for intended fluid type and service.
- B. Install pressure gauges as follows:
 - 1. At Pumps: Place single gauge before strainer, suction side and discharge side.
 - 2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.
- C. Install thermometers as follows:
 - 1. Hot Water Heaters: Place upstream and downstream of heater and mixing valve.

3.03 SCHEDULES

- A. Pressure Gauges, Location and Scale Range:
 - 1. Pumps, 0 to 100 psi.
- B. Stem Type Thermometers, Location and Scale Range:
 - 1. Domestic hot water supply and recirculation, 0 to 200 degrees F.

END OF SECTION

**SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Ball valves.
- B. Check valves.

1.02 RELATED REQUIREMENTS

- A. Section 220553 - Identification for Plumbing Piping and Equipment.
- B. Section 220719 - Plumbing Piping Insulation.
- C. Section 221005 - Plumbing Piping.

1.03 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

1.04 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- C. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2025.
- D. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
- E. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017 (Reapproved 2025).
- F. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- G. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- H. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- I. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.05 SUBMITTALS

- A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.06 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.

1.08 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

- A. Handle large valves with sling, modified to avoid damage to exposed parts.
- B. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball.
 - 2. Swing Check (Pump Outlet):
 - a. 2 inch and Smaller: Bronze swing check valves with nonmetallic disc.
- C. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Hand Lever: Quarter-turn valves 6 inch and smaller.
- D. Insulated Piping Valves: With 2 inch stem extensions and the following features:
 - 1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Solder Joint Connections: ASME B16.18.
- F. General ASME Compliance:
 - 1. Solder-joint Connections: ASME B16.18.
- G. Potable Water Use:
 - 1. Certified: Approved for use in compliance with NSF 61 and NSF 372.

2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, BALL VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged bronze.
5. Ends Connections: Pipe thread or solder.
6. Seats: PTFE.
7. Stem: Stainless steel, blowout proof.
8. Ball: Stainless steel, vented.
9. Operator: Provide lockable handle and stem extension.
10. Manufacturers:
 - a. Apollo.
 - b. NIBCO.
 - c. Watts.

2.04 BRONZE, LIFT CHECK VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:

1. Comply with MSS SP-80, Type 2, Nonmetallic Disc to Metal Seat.
2. CWP Rating: 200 psi.
3. Design: Vertical flow.
4. Body: Comply with ASTM B61 or ASTM B62, bronze.
5. End Connections: Threaded or soldered.
6. Manufacturers:
 - a. NIBCO.
 - b. Apollo.
 - c. Watts.

2.05 BRONZE, SWING CHECK VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:

1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.

3. WOG Rating: 200 psi.
4. Body: Bronze, ASTM B62.
5. End Connections: Threaded or soldered.
6. Disc: Nonmetallic.
7. Manufacturers:
 - a. Apollo.
 - b. NIBCO.
 - c. Watts.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Install check valves where necessary to maintain direction of flow as follows:
 1. Lift Check: Install with stem plumb and vertical.
 2. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION

**SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Strut systems for pipe or equipment support.
- B. Beam clamps.
- C. Pipe hangers.
- D. Pipe supports, guides, shields, and saddles.
- E. Nonpenetrating rooftop supports for low-slope roofs.
- F. Anchors and fasteners.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2025.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2025.
- J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- N. UL (DIR) - Online Certifications Directory; Current Edition.
- O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

1.05 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 50%. Include consideration for vibration, equipment operation, and shock loads where applicable.
- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.
- F. Materials for Metal Fabricated Supports:
1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.

- G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
 - 1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.

2.02 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

- A. Strut Channels:
 - 1. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
 - 2. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.
- B. Hanger Rods:
 - 1. Threaded zinc-plated steel unless otherwise indicated.
 - 2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch: 1/4 inch diameter.
 - c. Piping larger than 1 inch: 3/8 inch diameter.
- C. Channel Nuts:
 - 1. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

2.03 BEAM CLAMPS

- A. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
- B. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
- C. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
- D. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
- E. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
- F. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- G. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.04 PIPE HANGERS

- A. Clevis Hangers, Adjustable:
 - 1. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
 - 2. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
 - 3. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
 - 4. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.

2.05 PIPE CLAMPS

- A. Riser Clamps:
 - 1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.

2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

2.06 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Intermediate Anchors and Pipe Alignment Guides:
 1. Pipe Sizes 6 inch and Smaller: Minimum clearance of 0.16 inch.
 2. Pipe Size 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
 3. Pipe Size 10 inch: 0.75 inch U-bolt.
 4. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.
 5. Pipe Sizes 18 to 30 inches: 1 inch U-bolt.
 6. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
- C. Pipe Alignment Guides:
 1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
 2. Pipe Sizes 10 inch and Larger: Roller type.
- D. Pipe Shields for Insulated Piping:
 1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 2. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
 - d. Service Temperature: Minus 40 to 178 degrees F.
 - e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- E. Pipe Supports:
 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 2. Liquid Temperatures Up to 122 degrees F:
 - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
 - b. Support From Below: MSS SP-58 types 35 through 38.
- F. Pipe Supports, Thermal Insulated:
 1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
 - c. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.

- d. Provide pipe supports for 1/2 to 30 inch iron pipes.
- e. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
- 2. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
 - b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
 - c. Minimum Thickness: 60 mil, 0.06 inch.
- G. Copper Pipe Supports:

2.07 ANCHORS AND FASTENERS

- A. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- B. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- C. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- D. Hollow Masonry: Use toggle bolts.
- E. Hollow Stud Walls: Use toggle bolts.
- F. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
- G. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
- H. Sheet Metal: Use sheet metal screws.
- I. Wood: Use wood screws.
- J. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - 1. Channel Material: Use galvanized steel.
 - 2. Manufacturer: Same as manufacturer of metal strut channel framing system.
- K. Concrete Inserts:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. Equipment Support and Attachment:

1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Secure fasteners according to manufacturer's recommended torque settings.
- I. Remove temporary supports.

3.02 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.03 SUBMITTALS

- A. Product Data: Provide manufacturers catalog literature for each product required.
- B. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

- A. Nameplates:
 - 1. Heat exchangers, water heaters, and other heat transfer products.
 - 2. Control panels, transducers, and other related control equipment products.
 - 3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.
- B. Tags:
 - 1. Piping: 3/4 inch diameter and smaller.
 - 2. Manual operated and automated control valves.
 - 3. Instrumentation, relays, gauges, and other related control equipment products.
- C. Pipe Markers: 3/4 inch diameter and higher.

2.02 NAMEPLATES

- A. Description: Laminated piece with up to three lines of text.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: Black.
 - 4. Nameplate Height: 3/4 inch.

2.03 TAGS

- A. Metal: Stainless steel, 19 gauge 1-1/2 inch in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.

2.04 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- C. Identification Scheme, ASME A13.1:
 - 1. Primary: External Pipe Diameter, Uninsulated or Insulated.
 - a. 3/4 to 1-1/4 inches: Use 8 inch field-length with 1/2 inch text height.
 - b. 1-1/2 to 2 inches: Use 8 inch field-length with 3/4 inch text height.

2. Secondary: Color scheme per fluid service.
 - a. Flammable and Oxidizing Fluids: Black text on yellow background.
 - b. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive identification products.

3.02 INSTALLATION

- A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags in clear view and align with axis of piping
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Apply ASME A13.1 Pipe Marking Rules:
 1. Place pipe marker adjacent to changes in direction.
 2. Place pipe marker adjacent each valve port and flange end.
 3. Place pipe marker at both sides of floor and wall penetrations.
 4. Place pipe marker every 25 to 50 feet interval of straight run.

END OF SECTION

**SECTION 220719
PLUMBING PIPING INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass fiber insulation.
- B. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- B. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- C. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER INSULATION

- A. Manufacturers:

1. Johns Manville.
 2. Knauf.
 3. Owens Corning.
- B. Insulation: ASTM C547 and ASTM C795; rigid, preformed pipe insulation, noncombustible, with factory-applied matte finish all service jacket (ASJ).
1. K Value: ASTM C177, 0.24 at 75 degrees F.
 2. Maximum Service Temperature: 850 degrees F.
 3. Maximum Moisture Absorption: 0.2 percent by volume.

2.03 JACKETING AND ACCESSORIES

- A. PVC Plastic Jacket:
1. Jacket: One piece molded type fitting covers and sheet material, owhite color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with PVC fitting covers.
- F. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with PVC fitting covers.
- G. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert Location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

3.03 SCHEDULES

- A. Plumbing Systems:
1. Domestic Hot Water Supply and Recirculation:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: 1-1/4 inch and smaller.
 - a) Thickness: 1 inch.
 - 2) Pipe Size Range: 1-1/2 inch and larger.
 - a) Thickness: 1-1/2 inch.
 2. Domestic Cold Water:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: 1-1/4 inch and smaller.
 - a) Thickness: 1/2 inch.
 - 2) Pipe Size Range: 1-1/2 inch and larger.
 - a) Thickness: 1 inch.

END OF SECTION

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**SECTION 221005
PLUMBING PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary waste piping, buried.
- B. Domestic water piping, above grade.
- C. Pipe flanges, unions, and couplings.

1.02 RELATED REQUIREMENTS

- A. Section 220517 - Sleeves and Sleeve Seals for Plumbing Piping.
- B. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment.
- C. Section 220553 - Identification for Plumbing Piping and Equipment.
- D. Section 220719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- C. ASME B31.9 - Building Services Piping; 2025.
- D. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2025.
- E. ASTM B32 - Standard Specification for Solder Metal; 2020.
- F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- G. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- H. ASTM B813 - Standard Specification for Water Flushable Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2024.
- I. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.
- J. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- K. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020 (Reapproved 2024).
- L. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2025.
- M. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020 (Reapproved 2024).
- N. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2024, with Editorial Revision (2025).
- O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- P. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- Q. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- R. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, solder, and flux (if used), complying with NSF 61 and NSF 372; label pipe and fittings.
- B. Plenum-Installed Piping: Provide piping with flame spread index of 25 or less and smoke developed index of 50 or less when tested in accordance with ASTM E84 or UL 723.

2.02 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets.
- B. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type L, drawn temper.
 - 1. Fittings: ASME B16.22, wrought copper.
 - 2. Joints: ASTM B32 solder.

2.04 PIPE FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 inch and Under:
 - 1. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Sizes Over 1 inch:
 - 1. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

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

- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
- I. Install bell and spigot pipe with bell end upstream.
- J. Install valves with stems upright or horizontal, not inverted. See Section 220523.
- K. Install water piping to ASME B31.9.
- L. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- M. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

3.04 TOLERANCES

- A. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.05 FIELD TESTS AND INSPECTIONS

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Domestic Water Systems:
 - 1. Perform hydrostatic testing for leakage prior to system disinfection.
 - 2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
 - 3. General:
 - a. Fill the system with water and raise static head to 10 psi above service pressure. Minimum static head of 50 to 150 psi. As an exception, certain codes allow a maximum static pressure of 80 psi.
- C. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect water distribution system.
- B. Prior to starting work, verify system is complete, flushed, and clean.

3.07 SCHEDULES

- A. Pipe Hanger Spacing:
 - 1. Metal Piping:
 - a. Pipe Size: 1/2 inch to 1-1/4 inch:
 - 1) Maximum Hanger Spacing: 6.5 ft.
 - 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe Size: 1-1/2 inch to 2 inch:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.

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END OF SECTION

**SECTION 221119
DOMESTIC WATER PIPING SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mixing valves.
- B. Balancing valves.
- C. Strainers.
- D. Drain valves.

1.02 RELATED REQUIREMENTS

- A. Section 220519 - Meters and Gauges for Plumbing Piping: Thermometers, pressure gauges, and water meters.
- B. Section 221005 - Plumbing Piping: Pipe, fittings, and joints.

1.03 ABBREVIATIONS AND ACRONYMS

- A. DZR: Dezincification resistant.

1.04 REFERENCE STANDARDS

- A. ASSE 1017 - Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems; 2023.
- B. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- C. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on materials of fabrication, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.
- B. Manufacturer's Instructions: Provide for products listed below. Include instructions for handling, protection, examination, preparation, and installation.
 - 1. Thermostatic master mixing valves.
- C. Operation and Maintenance Data: Provide for products listed below.
 - 1. Thermostatic master mixing valves.
- D. Executed warranty.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- C. Store products under cover and protected from weather and dirt. Elevate above grade.
- D. Protect end connections, flanges, threads, and grooves from dirt and damage.
- E. Protect product interiors against rust and corrosion.
- F. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products complying with NSF 61 and NSF 372.

- B. Source Limitations: Furnish domestic water piping specialties of same kind by same manufacturer.
- C. Provide brass-bodied domestic water piping specialties in DZR brass.

2.02 MIXING VALVES

- A. Thermostatic Master Mixing Valves:
 - 1. Valve: ASSE 1017, brass or bronze body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment.
 - a. Finish: Rough bronze.
 - 2. Mixed-Water Temperature Setting: 125 degrees F.
 - 3. Accessories:
 - a. Strainer stop checks on inlets.
 - b. Shut-off valve on inlets and outlet.
 - c. Stem thermometer on outlet.

2.03 BALANCING VALVES

- A. Calibrated Balancing Valves and Circuit Setters:
 - 1. Valve: Brass, factory preset and calibrated, ball valve design, with metering ports, position indicator, and memory stop.
 - 2. Maximum Working Pressure: 150 psi.
 - 3. Working Temperature Range: 33 to 200 degrees F.

2.04 STRAINERS

- A. Manufacturers:
 - 1. NIBCO.
 - 2. Apollo.
 - 3. Watts.
- B. NPS 2 and Smaller:
 - 1. Body: Wye-pattern in brass, bronze, or copper silicon alloy.
 - 2. Screen: Stainless steel mesh.
 - 3. Pressure Rating: 200 psi.

2.05 DRAIN VALVES

- A. Ball-Valve Hose-End Drain Valves:
 - 1. Valve: Two-piece, full-port ball valve in brass or bronze with capped hose-end connection.
 - 2. Pressure Rating: 250 psi.
 - 3. Working Temperature Range: 33 to 140 degrees F.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard packing materials and verify product interiors are free from debris, damage, and corrosion.
- B. Verify end connections, flanges, threads, and grooves are completely clean without signs of damage or degradation that could result in leakage.
- C. For products containing isolation or shutoff valves, verify isolation and shutoff valves operate smoothly from fully closed to fully open.

3.02 INSTALLATION

- A. Prior to installation of domestic water piping specialties, flush domestic water piping of foreign material.
- B. Install products in accordance with manufacturer's instructions.
- C. Install products level and plumb.
- D. Install products with clearance for access and maintenance.
- E. Support products NPS 2-1/2 and larger independently of surrounding pipe.
- F. Support products with flanged or grooved ends independently of surrounding pipe.
- G. For products containing isolation or shutoff valves, locate valves in horizontal piping with stems at or above center of piping, maintaining unimpeded stem movement.
- H. Thermostatic Master Mixing Valves: Unless noted otherwise on drawings, install with centerline at 48 inches above finish floor.
- I. Balancing Valves: Install in accessible locations. Install shutoff valves on inlet and outlet.

3.03 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Repair or replace damaged products.
- C. Replace defective products.
- D. For products containing isolation or shutoff valves, exercise isolation and shutoff valves from fully closed to fully open. Confirm smooth operation.
- E. Mixing Valves: Confirm outlet temperature remains steady without fluctuation.
- F. Coordination of Other Tests and Inspections: Provide access to accommodate tests and inspections by independent testing agencies employed by Owner.

3.04 SYSTEM STARTUP

- A. Prepare and start products, equipment, and systems in accordance with manufacturers' instructions and recommendations.

3.05 ADJUSTING

- A. Adjust mixing valves to design temperature set point.
- B. Adjust balancing valves to design flow.

3.06 CLEANING

- A. Clean products to remove dirt, paint, and other foreign materials.
- B. Clean surfaces of products exposed to view in finished spaces to remove dirt, fingerprints, paint, and other foreign materials. Restore finishes to match original factory finish.
- C. Clean surfaces of products exposed to view on building exterior to remove dirt, fingerprints, paint, and other foreign materials. Restore finishes to match original factory finish.
- D. Clean strainers, including those internal to other products.

3.07 CLOSEOUT ACTIVITIES

- A. Demonstrate operation, adjusting, and maintenance of the following to Owner's designated personnel.

3.08 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.

END OF SECTION

Boiler Replacement & Related Work
at Several Schools
Monroe Public Schools

#26101, #26102
221119 - 4

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**SECTION 221123
DOMESTIC WATER PUMPS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Circulators.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NSF 61 - Drinking Water System Components - Health Effects; 2024.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Provide certified pump curve with duty point marked over pump and system operating conditions and NPSH curve and power requirement by pump tag.
 - 2. Manufacturer's catalog sheets for accessories and supplies.
- B. Test Reports: Plumbing fixture operational tests.
- C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Pump Seals: One of each type and size.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing type of products specified in this section, with minimum three years of documented experience.

1.06 WARRANTY

- A. Manufacturer Warranty: Provide 2-year manufacturer warranty for circulators. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 CIRCULATORS

- A. Manufacturers:
 - 1. Armstrong Fluid Technology
 - 2. Bell & Gossett, a Brand of Xylem (owner's preference)
 - 3. Grundfos Pumps Corporation
- B. Casing: Stainless steel with stainless steel impeller, and stainless steel rotor assembly.
- C. Shaft: Alloy steel with integral thrust collar and two oil-lubricated bronze sleeve bearings.
- D. Mechanical Seal: Carbon rotating against a stationary ceramic seat.

- E. Performance: As indicated on drawings.
- F. Pipe-End Connection: Flange connection.
- G. Motor: ECM duty with flexible coupling.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products with related fittings, and accessories according to manufacturer instructions.
- B. Potable and Drinking Water Service: Provide NSF 61 certified; comply with ICC (IPC).
- C. Ensure that small pressure gauges are installed on both upstream and downstream ends.
- D. Factory-Provided Pump Controls: Factory provided, tested for use.
- E. ECM Motors: Configure unit to operate within manufacturer-listed pump curve points unless factory set to do so. Then adjust to operate as indicated on drawings.
- F. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are nonoverloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

3.02 FIELD QUALITY CONTROL

- A. Operational Tests: Upon completion and sterilization of plumbing systems, conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.03 CLEANING

- A. Thoroughly clean plumbing fixtures and equipment.

3.04 PROTECTION

- A. Protect installed products from damage due from subsequent construction operations.
- B. Repair or replace products damaged before Date of Substantial Completion.

END OF SECTION

**SECTION 221319
SANITARY WASTE PIPING SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Floor drains.

1.02 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping.

1.03 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor Drains; 2022.
- B. NSF 14 - Plastics Piping System Components and Related Materials; 2023.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on fabrication materials, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- C. Store products under cover and protected from weather and dirt. Elevate above grade.
- D. Store plastic products protected from direct sunlight.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Plastic Sanitary Waste Piping Specialties: Provide plastic products that comply with NSF 14.
- B. Source Limitations: Furnish drains and sanitary waste piping specialties of same kind by same manufacturer.

2.02 FLOOR DRAINS

- A. Cast Iron Floor Drains:
 - 1. Manufacturers:
 - a. MIFAB.
 - b. Zurn.
 - c. Josam.
 - 2. Assembly: ASME A112.6.3.
 - 3. Body: Lacquered cast iron with anchor flange and membrane clamping collar with weepholes.
 - 4. Strainer: Adjustable, removable, with vandal-proof screws.
 - a. Round:
 - 1) Material: As indicated on drawings.
 - 2) Diameter: 6 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Maintain continuity of waterproofing membranes. Secure waterproofing membranes to drain clamping collars and bonding flanges.
- C. Install drains so strainers and grates are level and are at design elevation.

3.03 CLEANING

- A. Clean debris from drains.
- B. Clean grates and strainers.

3.04 PROTECTION

- A. Protect installed drains from accumulating dirt and debris through remainder of construction.
- B. Protect installed products from damage due to subsequent construction operations.

END OF SECTION

**SECTION 223000
PLUMBING EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial gas-fired water heaters.
- B. Commercial indirect water heaters.
- C. Diaphragm-type compression tanks.
- D. In-line circulator pumps.

1.02 RELATED REQUIREMENTS

- A. Section 221123 - Domestic Water Pumps.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .
- C. AWWA C652 - Disinfection of Water-Storage Facilities; 2019.
- D. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- E. NSF 61 - Drinking Water System Components - Health Effects; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; require attendance by affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. Product Data:
 - 1. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on materials of fabrication, assembly of components, dimensions, weights, capabilities, performance, electrical characteristics, location and sizes of connections, service and access locations, and manufacturer-provided and field-installed accessories.
- B. Manufacturer's qualification statement.
- C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

- A. Manufacturer Warranty: Provide 5-year manufacturer warranty for domestic water heaters and expansion tanks. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 WATER HEATERS

- A. Manufacturers:
1. A.O. Smith.
 2. Bradford White.
 3. Lochinvar.
- B. Commercial Gas-Fired Water Heaters:
1. Type: Automatic, natural gas-fired, vertical storage.
 2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
 3. Performance: Refer to contract documents.
 4. Tank: Antimicrobial-infused, enamel-lined, welded steel, ASME labeled; multiple flue passages, 4-inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
 5. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve.
 - d. Anode: Magnesium.
 - e. Temperature and Pressure Relief Valve: ASME labeled.
- C. Commercial Indirect Water Heaters:
1. Type: Automatic, indirect, vertical storage.
 2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
 3. Performance: Refer to contract documents.
 4. Tank: Glass lined welded steel ASME labeled; thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
 5. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve.
 - d. Anode: Magnesium.
 - e. Temperature and Pressure Relief Valve: ASME labeled.

2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
1. Amtrol.
 2. Bell & Gossett.
 3. Grundfos.

- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain.

2.03 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
 - 1. Armstrong Fluid Technology; _____: www.armstrongfluidtechnology.com/#sle.
- B. Casing: Stainless steel, rated for 125 psig working pressure, with stainless steel rotor assembly.
- C. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- D. Seal: Carbon rotating against a stationary ceramic seat.
- E. Drive: Flexible coupling.
- F. Performance: Refer to contract documents.

PART 3 EXECUTION

3.01 EXAMINATION

3.02 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions required for applicable certifications.
- B. Coordinate system, equipment, and piping work with applicable electrical, drain, and waste support interconnections as included or provided by other trades.
- C. Pumps:
 - 1. Provide air cock and drain connection on horizontal pump casings.
 - 2. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
 - 3. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
 - 4. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- D. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface.

3.03 FIELD QUALITY CONTROL

- A. Coordinate BAS, BMS, or Integrated Automation linking between water heater and boiler(s).

3.04 CLEANING

- A. Clean interior of water tanks and disinfect in accordance with AWWA C652.

END OF SECTION 223000

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**DIVISION 23
MECHANICAL SYSTEM SPECIFICATION INDEX**

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**SECTION 230511
BASIC MECHANICAL REQUIREMENTS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 23.

1.02 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installation. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:
 - 1. Maintenance manuals.
 - 2. Rough-in.
 - 3. Mechanical installations.
 - 4. Record (As-Built) Documents.
 - 5. Product Substitutions.

1.03 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1. In addition to the requirements specified in Division 1, include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.

1.04 RECORD (AS-BUILT) DOCUMENTS

- A. The Contractor shall keep an accurate record of all deviations from the contract drawings and specifications. He shall neatly and correctly enter in pencil any deviations on the drawings affected and shall keep drawings available for inspection. Extra set of transparencies will be furnished for this purpose. Submit As-Builts per 013000 - Administrative Requirements and 017000 - Execution and Closeout Requirements for review by the Architect. In addition to the requirements specified in Division 1, indicate the following installed conditions:
 - 1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
 - 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section "Identification for HVAC

Piping and Equipment." Indicate actual inverts and horizontal locations of underground piping.

3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
5. Contract Modifications, actual equipment and materials installed.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.06 CONTRACT DRAWINGS

- A. In general, drawings are schematic in nature and are intended as a guide to the Contractor, but do not necessarily show all details, offsets, etc. All drawings are to be thoroughly inspected.
- B. The Contractor's work shall conform to the information contained in this Specification and/or as indicated in the latest revision of the drawings referred to therein. The Contractor shall consult with the Engineer regarding all questions on which he may be in doubt before proceeding with fabrication of parts affected. The Contractor shall prepare all additional detail or field installation drawings necessary at his own expense. The Contractor shall verify all dimensions and conditions indicated on the Engineer's layout drawings and determine if any changes are required in conduits, piping runs, drains, ducts, etc., to avoid interference. Major changes shall not be made without the approval of the Engineer.
- C. While the drawings are to be adhered to as closely as possible, the Contractor has the right to vary the run of conduits, piping and/or ducts during progress of the work as may be found necessary or desirable to avoid interferences. Major revisions shall be verified with the Engineer.

1.07 VERIFICATION

- A. Before running any conduits, ducts, piping, etc., within the building, this Contractor shall assure himself that they can be installed as contemplated without trapping or interfering with columns, beams, piping, fixtures, etc. Any necessary major deviation shall be referred to the Engineer for adjustment before lines are installed, at no increase in contract price.
- B. Of necessity, openings, supporting steel, field-built curbs, electrical data, space requirements, etc., were designed around specific parameters. When the Contractor determines the manufacturer's model of equipment to be provided for the job, it shall be his responsibility to verify and coordinate unit dimensions with the General Contractor and all other interested Contractors on the job. It shall also become the Contractor's responsibility to change as necessary, through the Engineer, all required dimensions so that openings, supporting steel, curbs, electrical data, etc., will fit the equipment supplied. Any additional cost will be the sole responsibility of this Contractor.
- C. In addition, electrical power, interlock and control diagrams and piping arrangements were designed around one specific manufacturer. If additional wiring, piping controls, etc., are required for other equipment, this Contractor shall include the cost of same in his price.
- D. Dimensions, elevations and relative locations of existing equipment, sewers, pipes, ducts, conduits, etc., in place as shown on the drawings, are taken from as-built and record drawings and are deemed reliable only insofar as general layout is concerned. Such

dimensions shall not be used for layout drawings nor detailing of components. The responsibility for checking in place items will be the Contractors. All measurements, the exact determination of relative elevations or locations, the ascertaining of accuracy of all given elevations and dimensions and the obtaining of all necessary additional information to ensure the proper fit and coordination of all conduit equipment, ducts, and piping shall be the responsibility of the Contractor.

1.08 PRODUCT SUBSTITUTIONS

- A. The manufacturers listed in the equipment schedules are included as a basis of design. Submission of alternate manufacturers of similar equipment is subject to engineer approval. Units of equipment, other than those listed as the basis of design, must be proven to be physically acceptable, in addition to meeting all performance and equipment specifications. Liability of non-conformance shall lie with the Contractor/Submitter. Bidders desiring consideration for the use of material, equipment, etc. not named in the Specifications may submit in writing, at least ten (10) days prior to bid opening, the change including the specifications and description to the Architect for review and if approved, the change will be issued in an addendum at least five (5) days prior to the opening of bids.

PART 2 PRODUCTS

2.01 NOT APPLICABLE

PART 3 EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.02 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate mechanical systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 - 4. Coordinate the installation of required supporting devices, sleeves and other structural components, as they are constructed.
 - 5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 - 8. Install systems, materials, and equipment to conform with approved submittal data. Conform to arrangements indicated by the Contract Documents, recognizing that

portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

9. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnection, with minimum of interference with other installations. Extend grease fittings to an accessible location.
10. Install access panel or doors where units are concealed behind finished surfaces.
11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
12. Electrical requirements for mechanical equipment shall conform to the schedules indicated on the mechanical plans. Where such information is not included, this contractor shall coordinate the electrical requirements (i.e. voltage, phase, starter requirements, etc.) with those shown on the electrical drawings. If motors or equipment furnished hereunder, require more or larger starters, more or larger branch circuits, additional disconnects, etc., from that indicated on the mechanical drawings or specified herein, this contractor shall reimburse the Electrical Contractor for the cost differential he incurs. It is the responsibility of each contractor furnishing motors, to advise the Electrical Contractor of the exact function of the supplied systems to assure proper operation.

END OF SECTION 230511

**SECTION 230512
SUBMITTAL PROCEDURES**

PART 1 GENERAL

1.01 SUMMARY

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

1.02 DEFINITIONS

- A. Action Submittals: Written and graphic information that require Architect/Engineer's responsive action.
- B. Informational Submittals: Written and graphic information that do not require Architect/Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.03 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/Engineer and additional time for handling and reviewing submittals required by those corrections.

1.04 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect/Engineer's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will be provided by Architect/Engineer for Contractor's use in preparing submittals.
 - 1. Architect/Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect/Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. 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. Architect/Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect/Engineer'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 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 14 days for review of each resubmittal.
- D. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Stamp shall include project name, location, specification section, 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.

- E. 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.
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect/Engineer.
 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect/Engineer, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect/Engineer.
 - 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. Other necessary identification.
 - p. Remarks.
- F. Options: Identify options requiring selection by Architect/Engineer.
- G. Deviations: Identify deviations from the Contract Documents on submittals.
- H. 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 authorization notation from Architect/Engineer's action stamp.
 4. Resubmittal Limitation Requirements: The Architect/Engineer will provide time to review the original submittal and ONE resubmittal. If resubmittals are required pursuant to the first resubmittal, the Architect/Engineer's time for these services will be paid by the Contractor. The charges for this time will be back-charged from the Contractor as a change-order through this project's contract. These charges will be based upon the Architect/Engineering standard hourly rates (i.e. Engineer @ \$175.00/hr, etc.).
- I. 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.

- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with authorization notation from Architect/Engineer's action stamp.

PART 2 PRODUCTS

2.01 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements:
1. Issue electronic submittals as PDF electronic files directly to Architect/Engineer's e-mail address.
- 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:
 - a. Manufacturer's catalog cuts and Manufacturer's product specifications.
 - b. Standard color charts.
 - c. Statement of compliance with specified referenced standards.
 - d. Testing by recognized testing agency.
 - e. Application of testing agency labels and seals.
 - f. Notation of coordination requirements.
 - g. 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 in the PDF electronic file format.
- 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.
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 PDF electronic file format.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Submit product schedule in PDF electronic file format.

- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. 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.
- G. 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.
- H. 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.
- I. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- J. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- K. 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.
- L. 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.
- M. 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.
- N. 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.
- O. 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.
- P. 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
- Q. 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.

PART 3 EXECUTION

3.01 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/Engineer.
- B. 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.

3.02 ARCHITECT/ENGINEER'S ACTION

- A. General: Architect/Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action and Informational Submittals: Architect/Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect/Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - 1. Architect/Engineer's Review Status:
 - a. No Exceptions Taken
 - b. Exceptions Taken As Noted
 - c. Resubmit
 - d. Rejected
 - 2. Action Required of Contractor:
 - a. Process
 - b. Resubmit
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 230512

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**SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).

1.02 RELATED REQUIREMENTS

- A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.
- B. Section 262913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.
- C. NEMA MG 00001 - Motors and Generators; 2024.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Comply with NFPA 70.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service:
 - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
 - 2. Motors Larger than 1/2 Horsepower: 208 or 230 volts, three phase, 60 Hz.
- B. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 104 degrees F environment.
 - 3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- D. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.02 APPLICATIONS

- A. Single phase motors for shaft mounted fans and centrifugal pumps: Split phase type.
- B. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
- C. Single phase motors for fans, pumps, and blowers: Capacitor start type.
- D. Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type.

2.03 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.04 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.05 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.06 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Comply with NEMA MG 00001 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 262913.
- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- J. Sound Power Levels: To NEMA MG 00001.
- K. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- L. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- M. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.
- N. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

2.07 ELECTRONICALLY COMMUTATED MOTORS (ECM)

- A. Applications:

1. Commercial:
 - a. Hydronic Pump:
 - 1) Operating Mode: Constant speed.
 - 2) Input: Motor manufacturer to coordinate control requirements with the control board of the hydronic pump and/or specified sequence of operation.
 - 3) Flange Configuration: "C".

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 230513

**SECTION 230516
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS

- A. Section 232113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2025.
- B. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- C. EJMA (STDS) - EJMA Standards; Tenth Edition.
- D. FM (AG) - FM Approval Guide; Current Edition.
- E. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Design Data: Indicate selection calculations.
- D. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- E. Maintenance Data: Include adjustment instructions.
- F. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

PART 2 PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Inner Hose: Bronze.
- B. Exterior Sleeve: Single braided, stainless steel.
- C. Pressure Rating: 125 psi up to 12 inch.
- D. Maximum Service Temperature: 450 degrees F.
- E. End Connections: As specified for pipe joints.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/4 inch on each side of installed center line.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Inner Hose: Bronze.

- B. Exterior Sleeve: Braided bronze.
- C. Pressure Rating: 125 psi up to 2 inch.
- D. Maximum Service Temperature: 450 degrees F.
- E. End Connections: As specified for pipe joints.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/4 inch on each side of installed center line.
- H. Application: Copper piping.

2.03 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

- A. Pressure Rating: 125 psi and 400 degrees F.
- B. Maximum Compression: 1-3/4 inches.
- C. Maximum Extension: 1/4 inch.
- D. End Connections: Externally pressurized as specified for pipe joints.
- E. Size: Use pipe sized units.
- F. Application: Steel piping 3 inches and under.

2.04 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE

- A. Pressure Rating: 125 psi and 400 degrees F.
- B. Maximum Compression: 15/16 inch.
- C. Maximum Extension: 5/16 inch.
- D. Maximum Offset: 1/8 inch.
- E. End Connections: Flanged.
- F. Size: Use pipe sized units.
- G. Accessories: Internal flow liner and external shroud.
- H. Application: Steel piping over 2 inches.

2.05 EXPANSION JOINTS - SINGLE SPHERE, FLEXIBLE CONNECTOR

- A. Body Construction: Nylon-reinforced rubber tube.
- B. Cover and Tube Elastomer: EPDM and EPDM.
- C. End Connections: Carbon steel flanges.
- D. Maximum Compression: 1/2 inch.
- E. Maximum Elongation: 3/8 inch.
- F. Maximum Offset: 3/8 inch.
- G. Maximum Angular Movement: 15 degrees.
- H. Accessories: Control cables.
- I. Service Rating: Up to 150 psi at 200 degrees F.

2.06 EXPANSION JOINTS - TWO-PLY BRONZE BELLOWS TYPE

- A. Construction: Bronze with anti-torque device, limit stops, internal guides.
- B. Pressure Rating: 125 psi and 400 degrees F.
- C. Maximum Compression: 1-3/4 inches.
- D. Maximum Extension: 1/4 inch.
- E. End Connections: Soldered.
- F. Size: Use pipe sized units.
- G. Application: Copper piping.

2.07 EXPANSION JOINTS - COMPENSATORS

- A. Type: Two-ply 304 stainless steel bellows with carbon steel shroud.
- B. Maximum Working Pressure: 200 psi.
- C. Maximum Working Temperatures: 400 degrees F.
- D. Maximum Compression: 1/2 inch.
- E. Maximum Extension: 5/32 inch.
- F. End Connections: Female copper sweat.
- G. Application: Copper piping up to 3 inches in size or steel piping up to 4 inches in size.

2.08 EXPANSION JOINTS - STEEL WITH PACKED SLIDING SLEEVE

- A. Working Pressure and Temperature: Class 150.
- B. End Connections: Flanged.
- C. Size: Use pipe sized units.
- D. Application: Steel piping 2 inches and over.

2.09 EXPANSION JOINTS - COPPER WITH PACKED SLIDING SLEEVE

- A. Working Pressure: 125 psi.
- B. Maximum Temperature: 250 degrees F.
- C. End Connections: Flanged.
- D. Size: Use pipe sized units.
- E. Application: Copper or steel piping 2 inches and over.

2.10 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

- A. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.
- B. Maximum Allowable Motion: 2 inch in the x, y, and z planes with no thrust loads to the building structure
- C. Maximum Working Pressure: 150 psi at 800 degrees F.
- D. Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment
 - 1. Selected Product to Accommodate:
 - a. Angular Rotation: 15 degrees.
 - b. Force developed by 1.5 times specified maximum allowable operating pressure.
 - 2. Provide necessary accessories including, but not limited to, swivel joints.

2.11 EXPANSION JOINTS - EXTERNALLY PRESSURIZED

- A. Bellows Type: Two-ply, single bellows constructed of 304 stainless steel.
- B. Internal Liner: Carbon steel with internal and external guides.
- C. Specialty: Carbon steel anchor base, lifting lugs, and drain port with tapered plug.
- D. End Connections: Class 150, carbon steel, welded flange.
- E. Maximum Axial Compression: 4 inch.
- F. Maximum Working Pressure: 150 psi at 700 degrees F.
- G. Size: Use pipe sized units.
- H. Application: Steel piping 2 inches and over.

2.12 ACCESSORIES

- A. Pipe Alignment Guides:
- B. Engineered Riser Anchor Clamps:
 - 1. Applications:
 - a. Provide one clamp to serve as a riser clip.
 - 1) Verify the total load of filled pipe to be supported will be a safety factor of one less than the maximum loading of the clamp per the manufacturer's instructions.
 - b. Provide one clamp above and one clamp below the slab to anchor pipe.
 - 1) Coordinate with the structural engineer to determine the maximum thrust loading calculated for the slab or floor structure. Use the maximum thrust loading calculations to verify the clamps will be a safety factor of one less than the maximum loading of clamp per the manufacturer's instructions.
 - 2. Provide two piece, ductile iron in compliance with ASTM A536. Use with metal pipes with an outer diameter of 2.5 inches to 8 inches.
- C. Swivel Joints:
 - 1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION 230516

**SECTION 230517
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe-sleeve seals.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 099113 - Exterior Painting: Preparation and painting of exterior piping systems.
- C. Section 099123 - Interior Painting: Preparation and painting of interior piping systems.
- D. Section 230523 - General-Duty Valves for HVAC Piping.
- E. Section 230553 - Identification for HVAC Piping and Equipment: Piping identification.
- F. Section 230716 - HVAC Equipment Insulation.
- G. Section 230719 - HVAC Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
- C. FM (AG) - FM Approval Guide; Current Edition.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
 - 1. Minimum three years experience.
 - 2. Approved by manufacturer.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Vertical Piping:
1. Sleeve Length: 1 inch above finished floor.
 2. Provide sealant for watertight joint.
 3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
 4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
 2. Connect sleeve with floor plate except in mechanical rooms.
- D. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.
- E. Clearances:
1. Provide allowance for insulated piping.
 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
 3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

- A. Modular Mechanical Sleeve-Seal:
1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 3. Size and select seal component materials in accordance with service requirements.
 4. Service Requirements:
 - a. Fire Resistant: 1 hour, UL (DIR) approved.
 - b. High Temperature, up to 400 degrees F.
 5. Glass-reinforced plastic pressure end plates.
- B. Sealing Compounds:
1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 2. Combined packing and seal compound is to match partition fire-resistance hourly rating.
- C. Pipe Sleeve Material:
1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
 2. Masonry Structures: Sheet metal or fiber.
- D. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.
- E. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch thick.
- F. Pipeline-Casing Seals:
1. Coated boltless casing-spacer for 4 inch carrier pipe.

2. Coated boltless modular seal for 6 inch carrier pipe.
3. End Seals: 1/8 inch, pull-on type, rubber or synthetic rubber based.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
 1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations:
 1. Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 2. Aboveground Piping:
 - a. Pack solid using mineral fiber in compliance with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. Manufactured Sleeve-Seal Systems:
 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a water-tight seal.

- 6. Install in accordance with manufacturer's recommendations.
- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.
- C. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

END OF SECTION 230517

**SECTION 230519
METERS AND GAUGES FOR HVAC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flow meters.
- B. Pressure gauges and pressure gauge taps.
- C. Thermometers and thermometer wells.
- D. Static pressure gauges.

1.02 RELATED REQUIREMENTS

- A. Section 230923 - Direct-Digital Control System for HVAC.
- B. Section 232113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2025).
- B. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2025).
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- E. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- C. Project Record Documents: Record actual locations of components and instrumentation.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Pressure Gauges: One of each type and size.

1.05 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Size: 4-1/2 inch diameter.
 - 3. Mid-Scale Accuracy: One percent.
 - 4. Scale: Psi.

2.02 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.
- D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.03 STEM TYPE THERMOMETERS

- A. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
- B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.

2.04 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.05 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauges, one gauge adapters with 1/8 inch probes, two 1 inch dial thermometers.

2.06 STATIC PRESSURE GAUGES

- A. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- B. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- C. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide syphon on gauges in steam systems. Extend nipples and syphons to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- E. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 230943. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.

- F. Coil and conceal excess capillary on remote element instruments.
- G. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- H. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- I. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- J. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION 230519

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**SECTION 230523
GENERAL-DUTY VALVES FOR HVAC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Angle valves.
- B. Globe valves.
- C. Ball valves.
- D. Butterfly valves.
- E. Check valves.
- F. Gate valves.
- G. Plug valves.
- H. Chainwheels.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 230553 - Identification for HVAC Piping and Equipment.
- C. Section 230716 - HVAC Equipment Insulation.
- D. Section 230719 - HVAC Piping Insulation.
- E. Section 232113 - Hydronic Piping.

1.03 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

1.04 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.
- D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022, with Errata (2023).
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2025.
- G. ASME B31.9 - Building Services Piping; 2025.
- H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.

- I. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- J. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service; 2021.
- K. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- L. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017 (Reapproved 2025).
- M. MSS SP-45 - Drain and Bypass Connections; 2020.
- N. MSS SP-67 - Butterfly Valves; 2022.
- O. MSS SP-68 - High Pressure Butterfly Valves with Offset Design; 2021.
- P. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- Q. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- R. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- S. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- T. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends; 2011.
- U. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
 - 1. See Section 016000 - Product Requirements for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
 - 6. Adjust butterfly valves to closed or partially closed position.

- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- C. Exercise the following precautions for handling:
 - 1. Handle large valves with sling, modified to avoid damage to exposed parts.
 - 2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 MANUFACTURERS:

- A. Provide products by the following:
 - 1. Apollo
 - 2. Crane Co.
 - 3. Grinnell Corporation.
 - 4. Hammond Valve.
 - 5. Milwaukee Valve Company.
 - 6. Nexus Valve Specialties.
 - 7. NIBCO INC.
 - 8. Watts Industries, Inc.; Water Products Div.

2.02 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on drawings:
 - 1. Throttling (Hydronic): Butterfly, Ball, Globe, and Angle.
 - 2. Isolation (Shutoff): Butterfly and Ball.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves
 - 4. Swing Check (Pump Outlet):
 - a. Size 2 inch and Smaller: Bronze with bronze disc.
 - b. Size 2-1/2 inch and Larger: Iron with lever and weight, lever and spring, center-guided metal, or center-guided with resilient seat.
 - 5. Dead-End: Butterfly, single-flange (lug) type.
- D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- E. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:
 - a. Size 2 inch and Smaller: Threaded ends.
 - b. Size 2-1/2 inch and Larger: Flanged ends.
 - 2. Copper Tube:
 - a. Size 2 inch and Smaller: Threaded ends or solder-joint valve-ends, except provide valves with threaded ends for heating hot water.

- b. Size 2-1/2 inch and Larger: Flanged ends.
- F. Heating Hot Water Valves:
 - 1. Size 2 inch and Smaller, Brass and Bronze Valves:
 - a. Threaded ends.
 - b. Angle: Bronze disc, Class 125.
 - c. Ball: Full port, two piece, copper alloy trim..
 - d. Spring-Loaded Lift Disc Check Valves: Bronze disc, Class 125.
 - e. Gate: NRS, Class 125.
 - f. Globe: Type 2, Bronze disc, Class 125.
 - g. Lift Check: Type 2, Class 125, vertical, bronze.
 - h. Spring-Loaded, Lift-Disc Check Valves: Type IV, Class 125 minimum.
 - i. Swing Check: Type 4, Class 125, bronze.
 - 2. Size 2-1/2 inch and Larger, Iron Valves:
 - a. 2-1/2 inch to 4 inch: Flanged ends.
 - b. Ball: 2-1/2 inch to 10 inch, Class 150.
 - c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, ferrous alloy disc, EPDM seat, 150 CWP.
 - d. Single-Flange Butterfly: 14 inch to 24 inch, aluminum-bronze disc, EPDM seat, 150 CWP.
 - e. Swing Check: Type II, Class 125, gray iron.
 - f. Spring-Loaded, Lift-Disc Check Valves: Type I, Class 125, cast iron.
 - g. Swing Check: 2-1/2 inch to 12 inch, lever and spring closure control, Class 125.
 - h. Gate: NRS, Class 125.
 - i. Globe: Type 1, Class 124, bronze-mounted cast iron.

2.03 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Gear Actuator: Quarter-turn valves 8 inch and larger.
 - 2. Handwheel: Valves other than quarter-turn types.
 - 3. Hand Lever: Quarter-turn valves 6 inch and smaller.
 - 4. Wrench: Plug valves with square heads.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- D. Valves in Insulated Piping: Provide 2 inch stem extensions and the following features:
 - 1. Gate Valves: Rising stem.
 - 2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: Extended neck.
 - 4. Memory Stops: Fully adjustable after insulation is installed.
- E. Memory Stops: Fully adjustable after insulation is installed.
- F. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.

2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.
- G. General ASME Compliance:
 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 2. Building Services Piping Valves: ASME B31.9.
- H. Bronze Valves:
 1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- I. Valve Bypass and Drain Connections: MSS SP-45.
- J. Source Limitations: Obtain each valve type from a single manufacturer.

2.04 BRONZE, ANGLE VALVES

- A. CWP Rating: Class 125: 200 psi and Class 150: 300 psi:
 1. Comply with MSS SP-80, Type 1.
 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 3. Ends: Threaded.
 4. Stem: Bronze.
 5. Disc: Bronze, PTFE, or TFE.
 6. Packing: Asbestos free.
 7. Handwheel: Bronze or aluminum.

2.05 BRONZE, GLOBE VALVES

- A. CWP Rating: Type 1, Class 125: 200 psi:
 1. Comply with MSS SP-80, Type 1.
 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 3. Ends: Threaded or solder joint.
 4. Stem and Disc: Bronze.
 5. Packing: Asbestos free.
 6. Handwheel: Malleable iron.

2.06 IRON, GLOBE VALVES

- A. CWP Ratings: Type 1, Class 125: 200 psi and Class 250: 500 psi:
 1. Comply with MSS SP-85, Type I.
 2. Body: Gray iron; ASTM A126, with bolted bonnet.
 3. Ends: Flanged.
 4. Trim: Bronze.
 5. Packing and Gasket: Asbestos free.
 6. Operator: Handwheel or chainwheel.

2.07 CARBON STEEL, GLOBE VALVES

- A. Class 150:
 1. Body: ASTM A216/A216M.
 2. WOG Rating: 150 psi.
 3. Bonnet: NRS; Nonrising Stem.
 4. End Connections: Flanged.

5. Packing and Gasket: Asbestos free.
6. Operator: Malleable Iron handwheel.
7. Pressure and Temperature Rating: ASME B16.34.

2.08 COPPER-ALLOY, BALL VALVES

- A. Two Piece, Full Port and Standard Port with Copper-Alloy Trim and Female Thread, Male thread, or Solder Connections:
 1. Comply with MSS SP-110.
 2. SWP Rating: 150 psi.
 3. WOG Rating: 600 psi.
 4. Vacuum Rating: 28.9 in-Hg.
 5. Body: Bronze.
 6. Seats: PTFE.
 7. Blow-out Proof Stem: Stainless Steel.
 8. Ball: Chrome-plated brass.
 9. Hose-End Applications: Provide 3/4-inch hose connection. Include cap, gasket, and chain or tether.
 10. Operator: Lockable handle and memory stop.

2.09 CARBON STEEL, BALL VALVES

- A. Two Piece, Full Port with Stainless Steel Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi.
 3. CWP Rating: 2,000 psi.
 4. Seats: TFM.
 5. Stem: Stainless steel, blowout proof.
 6. Ball: Stainless steel, vented.
 7. End Connections: Threaded or socket weld.
 8. Operator: Lockable handle.
 9. Pressure and Temperature Rating: ASME B16.34.

2.10 IRON, BALL VALVES

- A. Split Body, Full Port:
 1. Comply with MSS SP-72.
 2. CWP Rating: 200 psi.
 3. Body: ASTM A126, gray iron.
 4. Ends: Flanged.
 5. Seats: PTFE.
 6. Stem: Stainless steel.
 7. Ball: Stainless steel.

2.11 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Wafer and Lug Style:
 1. Class 125 or 150.
 2. Comply with MSS SP-67, Type I.
 3. Wafer Style, CWP Ratings:

- a. Sizes 2 to 12 inches: 200 psi.
- b. Sizes 14 to 24 inches: 150 psi.
4. Lug Style, CWP Ratings:
 - a. Sizes 2 to 12 inches: 250 psi.
 - b. Sizes 14 to 24 inches: 150 psi.
5. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
6. Stem: One or two-piece stainless steel.
7. Seat: NBR.
8. Disc: Aluminum-bronze.
9. Service Temperature Range: Minus 30 to 250 degrees F.

2.12 HIGH-PERFORMANCE, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug type; Bidirectional dead end service without downstream flange:
 1. Comply with MSS SP-68.
 2. Class 150: CWP Rating: 285 psi at 100 degrees F.
 3. Body: Provide carbon steel or stainless steel.
 4. Seat: Reinforced PTFE.
 5. Offset stem: Stainless steel.
 6. Disc: Stainless steel.
 7. Operator: Gear operator with handwheel over direct-mount actuator base.

2.13 BRASS, INLINE CHECK VALVES

- A. Class 150: CWP Rating: 200 psi .
- B. Maximum Service Temperature: 250 degrees F.
- C. Body: Forged brass.
- D. Disc: Forged brass.
- E. Seal: PTFE, bubble tight.
- F. End-Connections: Press.

2.14 BRASS, HORIZONTAL SWING CHECK VALVES

- A. Threaded End-Connections:
 1. Class 125: CWP Rating: 200 psi.
 2. Body: Forged brass.
 3. Disc: Forged brass.
 4. Hinge-Pin, Screw, and Cap: Forged brass.

2.15 BRONZE, LIFT CHECK VALVES

- A. Class 125:
 1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
 2. CWP Rating: 200 psi.
 3. Design: Vertical flow.
 4. Body: Bronze.
 5. Ends: Threaded.
 6. Disc (Type 1): Bronze.
 7. Disc (Type 2): NBR or PTFE.

2.16 BRONZE, SWING CHECK VALVES

- A. Class 125:
 - 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 - 2. Design: Y-pattern, horizontal or vertical flow.
 - 3. WSP Rating: 200 psi.
 - 4. Body: Bronze, ASTM B62.
 - 5. End Connections: Threaded or soldered.
 - 6. Disc: Bronze.

2.17 IRON, FLANGED END SWING CHECK VALVES

- A. Class 125:
 - 1. 150 psi with metal seats.
 - 2. 200 psi with metal seats and nonmetallic-to-metal seats.

2.18 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125:
 - 1. Comply with MSS SP-71, Type I.
 - 2. Body Design: Clear or full waterway.
 - 3. Body Material: ASTM A126, gray iron with bolted bonnet.
 - 4. Ends: Flanged.
 - 5. Trim: Bronze.
 - 6. Gasket: Asbestos free.
 - 7. Closer Control: Factory installed, exterior lever, and spring or weight.

2.19 CARBON STEEL, SWING CHECK VALVES

- A. Class 150:
 - 1. Design: T-pattern, horizontal or vertical flow.
 - 2. Body and Disc: ASTM A216/A216M.
 - 3. CWP Rating: 150 psi.
 - 4. End Connections: Flanged.
 - 5. Pressure and Temperature Rating: ASME B16.34.

2.20 BRONZE, GATE VALVES

- A. Rising Stem or OS&Y:
 - 1. Pressure-Temperature Range: MSS SP-80, Type I.
 - 2. Class 125:
 - a. WSP Rating: 125 psi, saturated.
 - b. CWP Rating: 200 psi.
 - 3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
 - 4. End Connections: Threaded or solder.
 - 5. Stem: Bronze.
 - 6. Disc: Solid wedge; bronze.
 - 7. Packing: Asbestos free.
 - 8. Handwheel Operator: Malleable iron, bronze, or aluminum.
- B. Nonrising Stem or NRS:

1. Pressure-Temperature Range: MSS SP-80, Type I.
2. Class 125:
 - a. WSP Rating: 125 psi, saturated.
 - b. CWP Rating: 200 psi.
3. Class 150: CWP Rating; 300 psi.
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. Ends Connections: Threaded or solder.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel Operator: Malleable iron, bronze, or aluminum.

2.21 IRON, GATE VALVES

- A. NRS or OS&Y:
 1. Comply with MSS SP-70, Type I.
 2. Class 125:
 - a. Sizes 2-1/2 to 12 inch, CWP Rating; 200 psi.
 - b. Sizes 14 to 24 inch, CWP Rating; 500 psi.
 3. Body Material: Gray iron with bolted bonnet.
 4. Ends: Flanged.
 5. Trim: Bronze.
 6. Disc: Solid wedge.
 7. Packing and Gasket: Asbestos free.

2.22 CARBON STEEL, GATE VALVES

- A. Class 150:
 1. Body and Disc: ASTM A216/A216M.
 2. CWP Rating: 150 psi.
 3. Bolted Bonnet: OS&Y; Rising Stem.
 4. End Connections: Flanged.
 5. Packing and Gasket: Asbestos free.
 6. Pressure and Temperature Rating: ASME B16.34.
 7. Manufacturers:

2.23 SPRING-LOADED, LIFT-DISC CHECK VALVES

- A. Type III, Globe Lift-Disc Check Valves
- B. Type IV, Threaded Lift-Disc Check Valves

2.24 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to ball, butterfly, and plug valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
 4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Lift Check: Install with stem plumb and vertical.
 - 2. Swing Check: Install horizontal maintaining hinge pin level.
- E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 inches or more above finished floor, terminating 60 inches above finished floor.

END OF SECTION 230523

**SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components.
- B. Retrofit piping cover system.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2025.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- K. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- M. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- N. FM (AG) - FM Approval Guide; Current Edition.
- O. MFMA-4 - Metal Framing Standards Publication; 2004.
- P. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- Q. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- R. UL (DIR) - Online Certifications Directory; Current Edition.
- S. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
 - 1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
 - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- D. Installer's Qualifications: Include evidence of compliance with specified requirements.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

- B. Prefabricated Trapeze-Framed Metal Strut Systems:

1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MFMA-4 compliant, pre-fabricated, MSS SP-58 type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
3. MFMA-4 compliant, prefabricated, side-loading continuous-slot metal strut channel bracket with associated tracks, fittings, and related accessories.
4. Strut Channel or Bracket Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
7. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

- C. Prefabricated Trapeze-Framed Fiberglass Strut Systems:

1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. MSS SP-58 type 59, prefabricated continuous-slot fiberglass strut channel, associated fittings, and related accessories.
 3. Channel Material: Use polyester resin or vinyl ester resin.
 4. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
 5. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
- D. Strut Channels:
1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
 3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.
- E. Channel Nuts:
1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring.
- F. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
 2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch: 1/4 inch diameter.
 - c. Piping larger than 1 inch: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.
- G. Thermal Insulated Pipe Supports:
1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
 2. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
 - b. Minimum Service Temperature: Minus 40 degrees F.
 - c. Maximum Service Temperature: 180 degrees F.
 - d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.

- e. Thickness: 60 mil.
 - f. Connections: Brush on welding adhesive.
 - 3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- H. Pipe Supports:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - 3. Liquid Temperatures Up To 200 degrees F:
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
 - 4. Operating Temperatures from 122 to 446 degrees F:
 - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
 - b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
 - c. Sliding Support: MSS SP-58 Types 35 through 38.
- I. Nonpenetrating Pipe Supports:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish channels/struts and associated fittings, accessories, and hardware produced by a single manufacturer.
- J. Roller Chairs:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
 - 3. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.
 - 4. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.
- K. Pipe Stanchions:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 - 3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
 - 4. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
- L. Beam Clamps:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
 3. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
 4. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
 5. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
 6. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
 7. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
 8. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
 9. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
- M. Riser Clamps:
1. Manufacturers:
 2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 4. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 5. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
 6. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.
- N. U-Bolts:
1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 Type 24, carbon steel u-bolt for pipe support or anchoring.
- O. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- P. Strut Clamps:
1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
 3. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil.
 4. Service Temperature Range: Minus 65 to 275 degrees F.
- Q. Insulation Clamps:
1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Two bolt-type clamps designed for installation under insulation.
 3. Material: Carbon steel with epoxy copper or zinc finish.

R. Pipe Hangers:

1. Split Ring Hangers:
 - a. Manufacturers:
 - 1) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
 - c. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
 - d. Provide hanger rod and nuts of the same type and material for a given pipe run.
 - e. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
2. Band Hangers, Adjustable:
 - a. Manufacturers:
 - 1) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. MSS SP-58 Type 7 or 9, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
3. J-Hangers, Adjustable:
 - a. Manufacturers:
 - 1) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. MSS SP-58 Type 5, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 - c. Felt-Lining: Provide for uninsulated pipe to reduce noise and prevent static issues.
4. Swivel Ring Hangers, Adjustable:
 - a. Manufacturers:
 - 1) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. MSS SP-58 Type 10, epoxy-painted, zinc-colored.
 - c. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - d. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
 - e. Felt-Lining: Provide for uninsulated pipe to reduce noise and prevent static issues.
5. Clevis Hangers, Adjustable:
 - a. Manufacturers:
 - 1) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. Felt-Lined: MSS SP-58 Type 1, zinc-plated, silicone-free carbon steel.
 - c. Light-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
 - d. Standard-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
 - e. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch.

S. Intermediate Pipe Guides:

1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Pipe Diameter 6 inch and Smaller: Provide minimum clearance of 0.16 inch.

3. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
- T. Pipe Alignment Guides:
 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
- U. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- V. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- W. Pipe Shields for Insulated Piping:
 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
 - d. Minimum Service Temperature: Minus 40 degrees F.
 - e. Maximum Service Temperature: 200 degrees F.
 - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- X. Anchors and Fasteners:
 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 4. Hollow Masonry: Use toggle bolts.
 5. Hollow Stud Walls: Use toggle bolts.
 6. Steel: Use beam-ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
 7. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
 8. Sheet Metal: Use sheet metal screws.
 9. Wood: Use wood screws.
 10. Plastic and lead anchors are not permitted.

11. Powder-actuated fasteners are not permitted.
 12. Hammer-driven anchors and fasteners are not permitted.
 13. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
 - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
 14. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
- Y. Pipe Installation Accessories:
1. Copper Pipe Supports:
 - a. Manufacturers:
 - 1) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Thermal Insulated, Surface-Mounted Pipe Supports:
 - a. Manufacturers:
 - 1) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. Material: Carbon steel with epoxy copper or zinc finish.
 - c. Weather and UV light resistant foam, plastic, or rubber material with built-in strut.
Maximum Load: 50 lb for single pipe or multiple landed on top strut.
 3. Overhead Pipe Supports:
 - a. Manufacturers:
 - 1) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 4. Telescoping Pipe Supports:
 - a. Manufacturers:
 - 1) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 5. Inserts and Clamps:
 - a. Manufacturers:
 - 1) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2.02 RETROFIT PIPING COVER SYSTEM

- A. General Requirements:
1. Surface Burning Characteristics: Flame spread index/smoke developed index of 20/250, maximum, when tested in accordance with ASTM E84 or UL 723.
- B. Materials:
1. Piping Cover System: Removal-resistant, modular, snap-fit cover units, clips, and anchors for use with CPVC, steel, and copper piping systems.
 2. Cover Units: L-shaped and U-shaped cross-section units of flame retardant resin material, paintable finish.
 3. Unit Length: 7.5 feet.

4. Provide coupling fittings for joining units end to end and prefabricated inside and outside corner fittings and end caps as required.
5. Provide mounting clips to secure covers to wall-ceiling per manufacturer requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Architect.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.
 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- J. Secure fasteners according to manufacturer's recommended torque settings.
- K. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 230529

**SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Pipe labels.
 3. Duct labels.
 4. Stencils.
 5. Valve tags.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Material and Thickness: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Letter Color: White.
 3. Background Color: Red.
 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: White.

3. Background Color: Red White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.02 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.03 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Blue.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.04 STENCILS

- A. Stencils for Piping:

1. Lettering Size: Size letters according to ASME A13.1 for piping.
 2. Stencil Material: Aluminum.
 3. Stencil Paint: Exterior, gloss, acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
 4. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
- B. Stencils for Ducts:
1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
 2. Stencil Material: Aluminum.
 3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
 4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
- C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
 2. Stencil Material: Aluminum.
 3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
 4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

2.05 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

2.06 CEILING TAGS

- A. All HVAC equipment located above suspended ceilings shall include a label on ceiling grid with BAS equipment tag.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
 - 1. Chilled-Water Piping: White letters on a safety-green background.
 - 2. Heating Water Piping: White letters on a safety-green background Black letters on a safety-orange background.
 - 3. Refrigerant Piping: White letters on a safety-purple background.

3.05 DUCT LABEL INSTALLATION

- A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Yellow: For supply ducts.
 - 2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.06 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems as noted on contract documents, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Chilled Water: 1-1/2 inches, square.
 - b. Hot Water: 1-1/2 inches, square.

END OF SECTION 230553

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SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.

1.02 RELATED REQUIREMENTS

- A. Section 012100 - Allowances: Inspection and testing allowances.
- B. Section 230923 - Direct Digital Control System for HVAC

1.03 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: See Section 012100 for additional requirements.
- B. Allowance includes testing, adjusting, and balancing of mechanical systems.

1.04 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods; 2016, with Errata.
- C. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024, with Errata (2025).
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 3. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
 - 4. Include at least the following in the plan:
 - a. Preface: An explanation of the intended use of the control system.
 - b. List of all air flow, water flow, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - d. Identification and types of measurement instruments to be used and their most recent calibration date.
 - e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - f. Final test report forms to be used.

- g. Detailed step-by-step procedures for TAB work for each system and issue, including:
 - 1) Terminal flow calibration (for each terminal type).
 - 2) Diffuser proportioning.
 - 3) Branch/submain proportioning.
 - 4) Total flow calculations.
 - 5) Rechecking.
 - 6) Diversity issues.
 - h. Expected problems and solutions, etc.
 - i. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
 - j. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) air pitot traverse.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
 - k. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - l. Methods for making coil or other system plant capacity measurements, if specified.
 - m. Time schedule for TAB work to be done in phases.
 - n. Description of TAB work for areas to be built out later, if any.
 - o. Time schedule for deferred or seasonal TAB work, if specified.
 - p. False loading of systems to complete TAB work, if specified.
 - q. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - r. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - s. Procedures for formal progress reports, including scope and frequency.
 - t. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- E. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- 1. Submit to the Architect within two weeks after completion of testing, adjusting, and balancing.
 - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 6. Units of Measure: Report data in I-P (inch-pound) units only.
 - 7. Include the following on the title page of each report:

- a. Name of Testing, Adjusting, and Balancing Agency.
- b. Address of Testing, Adjusting, and Balancing Agency.
- c. Telephone number of Testing, Adjusting, and Balancing Agency.
- d. Project name.
- e. Project location.
- f. Project Architect.
- g. Project Contractor.
- h. Report date.

- F. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
1. AABC (NSTSB), AABC National Standards for Total System Balance.
 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 3. SMACNA (TAB).
 4. Maintain at least one copy of the standard to be used at project site at all times.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 2. Having minimum of three years documented experience.
 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council; upon completion submit AABC National Performance Guaranty.
 - b. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Duct systems are clean of debris.
 5. Fans are rotating correctly.

6. Air coil fins are cleaned and combed.
 7. Air outlets are installed and connected.
 8. Duct system leakage is minimized.
 9. Hydronic systems are flushed, filled, and vented.
 10. Pumps are rotating correctly.
 11. Strainers are clean and in place.
 12. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 10 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply and air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Adjust outside air automatic dampers, outside air and exhaust dampers for design conditions.
- I. Measure temperature conditions across outside air and relief/exhaust dampers to check leakage.

3.07 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.08 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Plumbing Pumps.
 - 2. HVAC Pumps.
 - 3. Water Tube Boilers.
 - 4. Electric Unit Heaters.
 - 5. Fans.
 - 6. Gravity Hoods and Louvers.
 - 7. Ductwork Leakage.

3.09 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 - 1. Manufacturer.
 - 2. Model/Frame.
 - 3. HP/BHP.
 - 4. Phase, voltage, amperage; nameplate, actual, no load.
 - 5. RPM.
 - 6. Service factor.
 - 7. Starter size, rating, heater elements.
 - 8. Sheave Make/Size/Bore.
- B. V-Belt Drives:
 - 1. Identification/location.
 - 2. Required driven RPM.
 - 3. Driven sheave, diameter and RPM.
 - 4. Belt, size and quantity.
 - 5. Motor sheave diameter and RPM.
 - 6. Center to center distance, maximum, minimum, and actual.
- C. Pumps:
 - 1. Identification/number.
 - 2. Manufacturer.
 - 3. Size/model.
 - 4. Impeller.
 - 5. Service.
 - 6. Design flow rate, pressure drop, BHP.
 - 7. Actual flow rate, pressure drop, BHP.
 - 8. Discharge pressure.
 - 9. Suction pressure.
 - 10. Total operating head pressure.
 - 11. Shut off, discharge and suction pressures.
 - 12. Shut off, total head pressure.
- D. Combustion Equipment:
 - 1. Boiler manufacturer.
 - 2. Model number.
 - 3. Serial number.
 - 4. Firing rate.
 - 5. Overfire draft.
 - 6. Gas meter timing dial size.
 - 7. Gas meter time per revolution.
 - 8. Gas pressure at meter outlet.
 - 9. Gas flow rate.
 - 10. Heat input.
 - 11. Burner manifold gas pressure.

12. Percent carbon monoxide (CO).
13. Percent carbon dioxide (CO₂).
14. Percent oxygen (O₂).
15. Percent excess air.
16. Flue gas temperature at outlet.
17. Ambient temperature.
18. Percent combustion efficiency.
19. Heat output.
- E. Electric Unit Heaters:
 1. Manufacturer.
 2. Identification/number.
 3. Location.
 4. Model number.
 5. Design kW.
 6. Number of stages.
 7. Phase, voltage, amperage.
 8. Test voltage (each phase).
 9. Test amperage (each phase).
 10. Air flow, specified and actual.
 11. Temperature rise, specified and actual.
- F. Gravity Hoods and Louvers:
 1. Location
 2. Manufacturer
 3. Model number.
 4. Serial number.
 5. Identification/location.
 6. Design air flow.
 7. Actual air flow.
 8. Total static pressure (total external), specified and actual.
 9. Inlet pressure.
 10. Discharge pressure.
- G. Supply Fans:
 1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.
 11. Fan RPM.

H. Duct Leak Tests:

1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test static pressure.
7. Leakage.

END OF SECTION 230593

**SECTION 230713
DUCT INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Weather barrier coatings.

1.02 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 078400 - Firestopping.
- C. Section 230553 - Identification for HVAC Piping and Equipment.
- D. Section 233100 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- E. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. CertainTeed Corporation.
 - 2. Johns Manville.
 - 3. Knauf Insulation.
 - 4. Owens Corning Corporation.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 250 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. CertainTeed Corporation.
 - 2. Johns Manville.
 - 3. Knauf Insulation.
 - 4. Owens Corning Corporation.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C612; rigid, noncombustible.
 - 1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent.
 - 4. Maximum Density: 8.0 pcf.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated Ducts Conveying Air Below Ambient Temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated Ducts Conveying Air Above Ambient Temperature:
 - 1. Provide with or without standard vapor barrier jacket.

- 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- F. Slope exterior ductwork to shed water.

END OF SECTION 230713

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**SECTION 230716
HVAC EQUIPMENT INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Equipment insulation.
- B. Flexible removable and reusable blanket insulation.

1.02 RELATED REQUIREMENTS

- A. Section 230553 - Identification for HVAC Piping and Equipment.
- B. Section 232113 - Hydronic Piping: Placement of hangers and hanger inserts.
- C. Section 232114 - Hydronic Specialties.

1.03 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- D. ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks; 2025.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. Johns Manville Corporation
 - 2. Knauf Insulation
 - 3. Owens Corning Corporation
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C553; flexible, noncombustible.
 - 1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 1,000 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Insulation: ASTM C1393; pipe and tank, end grain adhered to jacket.
 - 1. K Value: ASTM C177, 0.27 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.03 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

- A. Description: Custom cut and fabricated, removable and reusable blanket insulation system, consisting of inner liner, insulation layer, outer protective jacket, and fastening system.
- B. Provide insulation system based on surface temperature of piping, installed location of piping, and maximum safe-to-touch temperature of jacketing.
- C. Performance Criteria:
 - 1. Maximum Service Temperature: Constructed for temperatures up to 500 degrees F.
 - 2. Safe-to-Touch Temperature of Jacketing: 140 degrees F.
 - 3. Space Ambient Temperature, High: 85 degrees F.
 - 4. Space Ambient Temperature, Low: 40 degrees F.
- D. Components:
 - 1. Inner Liner: Use stainless steel mesh or silicone-impregnated fiberglass.
 - 2. Insulation:
 - a. Material: Needled fiberglass felt mat.
 - b. Thickness: 1 inch.

- c. Density: 11 pcf.
- d. Thermal Conductivity k-factor in Btu inch/hr sq ft degrees F: 0.50 at 500 degrees F.
- e. Outer Jacket: Silicone-impregnated fiberglass.
- f. Fastening System: Lacing wire.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- G. Fiber glass insulated equipment containing fluids above ambient temperature; provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- H. Inserts and Shields:
 - 1. Application: Equipment 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between hangers and inserts.
 - 3. Insert Location: Between support shield and equipment and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Finish insulation at supports, protrusions, and interruptions.
- J. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- K. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
- L. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- M. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

END OF SECTION 230716

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**SECTION 230719
HVAC PIPING INSULATION**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM - Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air; 1417.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2025a.
- C. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging; 2018.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- F. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- G. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2022.
- H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- I. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.
- J. ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks; 2025.
- K. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds; 2025.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section includes insulation for HVAC piping systems.
- B. Related Sections:
 - 1. Section 23- 07 13 "Duct Insulation" for duct insulation.
 - 2. Section 23 -07 16 "HVAC Equipment Insulation" for equipment insulation.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 2. Sheet Form Insulation Materials: 12 inches square.
 3. Jacket Materials for Pipe: 12 inches long by NPS 2.
 4. Sheet Jacket Materials: 12 inches square.
 5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, 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.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.08 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 - Hangers and Supports for HVAC Piping and Equipment.
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.09 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - 1. Preformed Pipe Insulation: Type II, Class 1, without jacket.
 - 2. Preformed Pipe Insulation: Type II, Class 2, with factory-applied ASJ jacket.
 - 3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials, Type II for sheet materials.
- H. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
 - 1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
 - 2. 850 deg F.
 - 3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral-Fiber, Pipe and Tank: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C1393.
 - 1. Semirigid board material with factory-applied ASJ jacket.
 - 2. Nominal density is 2.5 lb/cu. ft. or more.
 - 3. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Adhesive: As recommended by jacket material manufacturer.
 - 2. Color: White.
 - 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.03 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 6.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.04 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.
 - 2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.
 - 3. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 1. Comply with requirements in Section 07-8413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07-8413 "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two (2) times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed sections of cellular-glass insulation to valve body.
 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.

3.07 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturers' recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
 4. 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.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturers' recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.08 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.09 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09-9113 "Exterior Painting" and Section 09-9123 "Interior Painting."
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.

- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

- A. All insulation applications will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size shall comply with Pipe material Construction & Insulation Schedule located on the contract documents in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Underground piping.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

END OF SECTION 230719

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**SECTION 230923
DIRECT DIGITAL CONTROL SYSTEM FOR HVAC**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Open, Inoperable, Integrated Architectures
- B. Interoperable Digital Controller (EDC)
- C. Other Control System Hardware
- D. Actuators
- E. Control Valves
- F. Power Monitoring Interface

1.02 RELATED REQUIREMENTS

- A. Refer to Section 230553 "Identification for HVAC Piping and Equipment" for requirements associated with labeling of control equipment.
- B. Division 26 Electrical:
 - 1. Providing motor starters and disconnect switches (unless otherwise noted).
 - 2. Provision, installation and wiring of smoke detectors (unless otherwise noted).

1.03 ABBREVIATIONS AND ACRONYMS

- A. Acronyms used in this specification are as follows:
 - 1. FMCS: Facility Management and Control System
 - 2. TCS: Temperature Control System
 - 3. UNC: Universal Network Controller
 - 4. IDC: Interoperable Digital Controller
 - 5. IBC: Interoperable BACnet Controller
 - 6. GUI: Graphical User Interface
 - 7. WBI: Web Browser Interface
 - 8. POT: Portable Operator's Terminal
 - 9. PMI: Power Measurement Interface
 - 10. DDC: Direct Digital Controls
 - 11. LAN: Local Area Network
 - 12. WAN: Wide Area Network
 - 13. OOT: Object Oriented Technology
 - 14. PICS: Product Interoperability Compliance Statement

1.04 SUMMARY

- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.
- B. All labor, material, equipment and software not specifically referred to herein or on the plans, that are required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.
- C. All existing HVAC equipment and controls, as indicated on drawings, shall be added to the DDC temperature control system.

1.05 SYSTEM DESCRIPTION

- A. The entire Temperature Control System (TCS) shall be comprised of a network of OPEN PROTOCOL, interoperable, stand-alone digital controllers via LonMark/LonTalk communication protocol to a Universal Network Controller (UNC).
- B. Drawings of temperature control systems are diagrammatic only and any apparatus not shown, such as relays, accessories, etc., but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.

1.06 INSTALLER REQUIREMENTS

- A. 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 or its exclusive factory authorized installing contracting field office (representative).
- B. The installing office shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the local exclusive factory authorized temperature control contracting field office (branch or representative). Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

1.07 SUBMITTALS

- A. Refer to Section 230512 "Submittal Procedures" for requirements.
- B. Do not base Submittals on reproductions of the Contract Documents.
- C. Shop drawing submittals shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package.
- D. Submittal shall also include a complete point list of all connected points to the DDC system in the format as indicated in the temperature control system diagrams located on the drawings.
- E. Upon completion of the work, provide a complete set of 'as-built' drawings and application software. Submit As-Built per Specification S013000 - Administrative Requirements and 017000 - Execution and Closeout Requirements for review by the Architect.

1.08 QUALITY ASSURANCE

- A. The manufacturer of the TCC digital controllers shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). Product literature provided by the TCSC digital controller manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.10 WARRANTY

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of two years from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the contractor at no expense to the Owner.
- C. Warranty Access: The owner shall grant to the Division 230800 contractor, reasonable access to the TCS during the warranty period.

1.11 AGENCY AND CODE APPROVALS

- A. All products of the FMCS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
 - 1. UL-916; Energy Management Systems
 - 2. FCC, Part 15, Subpart J, Class A computing Devices

1.12 SOFTWARE LICENSE AGREEMENT

- A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement but shall protect manufacturer's rights to disclosure of trade secrets within such software.

1.13 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Automated Logic Installed by CSO (419) 887-1611
- B. Source Limitations: Furnish products produced by same manufacturer as other control systems, produced by single manufacturer, and obtained from single supplier.

2.02 GENERAL

- A. The temperature Control System (TCS) shall be comprised of a network of OPEN PROTOCOL, interoperable, stand-alone digital controllers and other devices as specified herein.

2.03 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet and LonWorks technology communication protocols.

- B. Controller and System HVAC Applications if documented by the specified sequence of operations.
 - 1. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, occupied/unoccupied setback/setup, DDC with PID and trend logging.
 - 2. Boiler Control Programs: Boiler plant optimization with hot water reset, boiler and pump equipment selection and sequencing.
 - 3. Programming Application Features: Trend point, alarm reporting, alarm lockout, weekly scheduling, staggered start, sequencing, anti-short cycling and calculated point.

2.04 INTEROPERABLE DIGITAL CONTROLLER (IDC)

- A. Controls shall be microprocessor based Interoperable LonMark or LonWorks Controllers (IDC). Where possible, all Interoperable Digital Controllers shall bear the applicable LonMark interoperability logo on each product delivered. Temperature controllers must be capable of custom programming; configuration only controllers are not acceptable.
- B. Custom Application Control Units: Modular, comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control applications. CAC's shall be provided for Air-Handling Units, boiler Plant, Chiller Plant and other applications as shown on drawings and shall have published LonWorks™ application source code, device resource files and external interface definitions.
 - 1. Units monitor or control each input/output point: process information; and least 50 expressions for customized HVAC control including mathematical equations, Boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, enthalpy calculation, counters, interlocks, ramps, drivers, schedules, calendars, OSS, compare, limit, curve fit, and alarms.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Peer to peer primary network level communications supporting at least 200 LonMark™ Standard Network Variables (SNVTs) per CAC utilizing at least 100 different SNCT types as documented by the LonMark™ devices. The 200 LonMark™ SNVTs, minimum, must be configurable in any combination – all inputs or all outputs or any combination of input/outputs in any combination of the 100 different, minimum, SNVT types. The XIF SNVT order shall be definable, rather than random, to provide logical and effective LonMark™ network management. With the submittal package, contractor shall provide CAC performance data that specifies the exact maximum number of SNVTs available in any combination and a list of all available SNVT types including the LonMark™ Interoperability Association SNVT number.
 - b. Automatic communications loss detection to maintain normal control functionally regardless of available network communications.
 - c. Discrete/digital, analog and pulse input/outputs.
 - d. Local energy management control strategies.
 - 3. Incorporate internal customizable safeties and limits to prevent third party LonMark™ tools from providing improper and unrealistic inputs to CAC's. Local operator interface port provides for download from and connection to portable workstation.
 - 4. Communication: The Custom Application Controller shall communicate via the Primary Controller Network between BMS Controllers and other LonWorks™ devices. CAC's

shall communicate with the Building Controller and ASC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 790.1).

- C. HVAC control shall be accomplished using LonMark™ based devices where the application has a LonMark profile defined. Where LonMark devices are not available for a particular application, devices based on LonWorks shall be acceptable.
- D. All IDCs shall be fully application programmable and shall at all times maintain their LonMark certification, if so certified. Controllers offering application selection only (non-programmable) are NOT acceptable. All control sequences within or programmed into the IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
- E. The contractor supplying the IDC's shall provide documentation for each device, with the following information at a minimum:
 - 1. Network Variable Inputs (nvi's); name and type
 - 2. Network Variable Outputs (nvo's); name and type
 - 3. Network configuration parameters (nci, nco); name and type
- F. It is the responsibility of the Division 230800 contractor to ensure that the proper Network Variable Inputs and Outputs (nvi and nvo) are provided in each IDC, as required by the point charts.
- G. The TCS contractor shall supply one copy of the software used for control system access and programming to the owner. The contractor shall install the software on a laptop computer supplied by the owner. Any required cables for connection between the laptop computer and the IDCs shall be supplied by the contractor. The contractor shall provide a means of viewing all points, overriding or commanding inputs and outputs, changing set points, and changing schedules for all systems using the laptop computer. Graphics are not required for each system, but at a minimum, a points list shall be programmed in an organized manner for each system. Point names matching the submittal point names shall be used in the points list.

2.05 OTHER CONTROL SYSTEM HARDWARE

- A. Local Control Panels: Unitized NEMA 1 cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
 - 1. Fabricate panels of 0.06-inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
 - 2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection, on all input/output name abbreviations shall be individually identified using a labeler, per control drawings, documents and the system interface. These labels shall be affixed to the cable at the control panel terminations as well as the field device termination.
 - 3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, thermometers, and gages.
 - 4. Provided ON/OFF power switch with over-current protection for control power sources to each local panel.

- B. Sensors:
1. Electronic Temperature Sensors: Vibration and corrosion resistant; for wall, immersion, or pipe mounting as required.
 2. Resistance Temperature Detectors: Platinum, thermistor, or balco.
 - a. Accuracy: Plus or minus 0.2 percent at calibration point; thermistors shall have a maximum 5 year drift of no more than 0.225°F maximum error of no more than 0.36°F.
 - b. Wire: Twisted, shielded-pair cable.
 - c. Insertion Elements in Ducts: Single point, 6 inches long; use where not affected by temperature stratification or where ducts are smaller than 4 sq. ft.
 - d. Averaging Elements in Ducts: 60 inches, long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264 inches long, flexible for use, where prone temperature stratification or where ducts are larger than 16 sq. ft.; length as required.
 - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2½ inches.
 - f. Outside-Air Sensors: Watertight inlet fitting, shielding from direct sunlight.
 - g. Room Security Sensors: Stainless steel cover plate with insulated back and security screws.
 3. Configure to send automated email notifications on prioritized findings and support customized report generation through online interface.
- C. Equipment operation sensors as follows:
1. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
 2. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable trip point, split core with an integral LED for trip indication and set to 175 percent of rated motor current.
- D. Electronic Valve Position Indication: Visual scale indicating percent of travel and 2 to 10-V dc, feedback signal.
- E. Water-Flow Switches: Pressure-flow switches of bellows actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless steel or bronze paddle. For chilled water applications, provide vapor proof type.
- F. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
- G. Line-Voltage, ON-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break underground conductors.
 2. Dead Band: Maximum 2°F.
- H. Remote-Bulb Thermostats: On-Off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.
1. Bulbs in water lines with separate wells of same material as bulb.
 2. Bulbs in air ducts with flanges and shields.
 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.

4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 5. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.
 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- I. Room Thermostat: To be located in all occupied locations example Classrooms, Conference Rooms, Offices.
1. Set-Point Adjustment: Exposed
 2. Function: Temperature, CO2 & humidity
 3. Thermometer: LCD display
 4. Color: Neutral
 5. Orientation: Vertical
- J. Tamper Proof Room Thermostat: To be located in all non continuous occupied locations example Corridors, Restrooms, Storage Rooms, Mechanical Rooms.
1. Set-Point Adjustment: Exposed
 2. Function: Temperature, CO2 & humidity
 3. Thermometer: Tamper Resistant
 4. Color: Stainless Steel
 5. Orientation: Vertical
- K. Room thermostat accessories include the following:
1. Insulating Bases: For thermostats located on exterior walls.
 2. Thermostat Guards: As specified in tamper prone areas.
 3. Adjusting Key: As required for calibration and cover screws.

2.06 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth, modulating action or two-position action under all environmental conditions (temperature, low power voltage fluctuations, tight seal damper design, maximum air and water flow forces).
1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Valve Actuators: Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. The actuator shall have rating of not less than twice the thrust needed for actual operation of the damper or valve.
1. Coupling: V-bolt and V-shaped, toothed cradle.
 2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 3. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release non-spring-return actuators.
 4. Actuators shall have the ability to be tandem mounted.

5. All spring-return actuators shall have a manual override. Complete manual override shall take no more than 10 turns.
6. Power Requirements (Two-Position Spring Return): 24V ac or dc, Maximum 10VA.
7. Power Requirements (Modulating): Maximum 15 VA at 24V ac.
8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
9. Temperature Rating: -22°F to 140°F.
10. Run Time: 220 seconds open, 40 seconds closed.
11. All actuators shall have a 5 year warranty.
12. Valves:
 - a. Size for torque required for valve close-off at maximum pump differential pressure (regardless of water loop system pressures).
 - b. Valve and Actuators shall come from the factory fully assembled.
 - c. Spring Return Manual Override shall come with a 10 Degree Valve Preload to assure tight close off.

2.07 CONTROL VALVES

- A. General: Control valves shall be 2-way or 3-way pattern as shown constructed for tight shutoff and shall operate satisfactorily against system pressures and differentials. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Valves with sizes up to and including 2 inches shall be "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration. Electrically controlled valves shall include spring return type actuators sized for tight shut-off against system pressures and furnished with integral switches for indication of valve position (open-closed).

2.08 POWER MONITORING INTERFACE

- A. General: The Power Measurement Interface (PMI) device shall include the appropriate current and potential (voltage) transformers. The PMI shall be certified under UL-3111. The PMI shall perform continuous true RMS measurement based on 32 samples-per-cycle sampling on all voltage and current signals. The PMI shall provide outputs to the FMCS based on the measurement and calculation of the following parameters: (a) current for each phase and average of all three phases, (b) kW for each phase and total of all three phases, (c) power factor for each phase and all three phases, (d) percent voltage unbalance and (e) percent current unbalance. These output values shall be hard-wired inputs to the FMCS or shall be communicated to the FMCS over the open-protocol LAN.

PART 3 EXECUTION

3.01 GENERAL

- A. Install equipment level and plumb.
- B. Install software in control units and operation workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 48 inches above the floor in accordance with ADA requirements. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

- E. Install labels and nameplates to identify control components according to Section 230553 "Identification for Piping & Equipment". The names on the labels shall match the point names given on the computer graphics display and also shown on the as-built drawings.
- F. Install hydronic instrument wells, valves, and other accessories according to Sections 232113 "Hydronic Piping" and 232114 "Hydronic Piping Specialties."
- G. Install electronic and fiber-optic cables according to Division 26.

3.02 ACCEPTANCE TESTING

- A. The contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications. The contractors shall coordinate the checkout of the system such that each Division has a representative present during system checkout.
- B. The contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.
- D. System Acceptance: Satisfactory completion is when the Temperature Control sub-contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System shall be contingent upon completion and review of all corrected deficiencies.
- E. As-builts/ Field Walk Through: Upon completion of installation and testing, Contractor shall provide detailed as-builts of all installed systems including but not limited to floor plans that show exact location for all equipment controllers and controls panels. This will be followed up with a walk through including a representative chosen by the owner and the installing contractor, scheduled and coordinated in writing in which the contractor shall walk the owner through the work area and physically show the location of all panels and controllers. The Contractor shall provide as built drawings and have the owner and contractor representatives initial each location verified. This document will be submitted for record in the close out documents.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing. Calibration and test electric/electronic thermostats by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Replace damaged or malfunctioning controls and equipment.
 - 1. Start, test and adjust control systems.
 - 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 - 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- C. Verify DDC as follows:

1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
2. Verify operation of operator workstation.
3. Verify local control units including self-diagnostics.

3.04 COMMUNICATION INTERFACE TO OTHER BUILDING SYSTEMS

- A. DDC system shall have a communication interface with systems having a communication interface.
- B. Configuration Bits: The boiler shall provide an address which allows configuration bits to be received. The TCS contractor shall send bits from the BAS to the boiler. The bits are intended to tell the boiler to use its on-board inputs.

3.05 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26.
- B. Install building wire and cable according to Division 26.
- C. Install signal and communication cable according to Division 26.
 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 2. Install exposed cable in raceway.
 3. Install concealed cable in raceway.
 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 5. Fasten flexible conductor, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlocks and controls when switch is in hand position (i.e. safeties and other Life safety shutdown functions shall NOT be overridden by the "hand" position. Life safety shutdown functions shall also operate in the full speed "Bypass" mode where such is provided for VFD's.

3.06 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment. 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 and UL 486B.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing and maintaining equipment and schedules.

2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 40 hours dedicated instructor time on-site.
3. Review data in maintenance manuals.
4. Schedule training with Owner, through Architect, with at least seven day's advance notice.

3.08 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide 25 hours on site, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.09 TRAINING

- A. Provide a minimum of 12 hours of on-site or classroom training throughout the contract period for personnel designated by the Owner. Each session shall be a minimum of four hours in length and must be coordinated with the building Owner. Train the designated staff of Owners Representative and Owner to enable them to:
 1. Proficiently operate the system.
 2. Understand control system architecture and configuration.
 3. Understand DC system components.
 4. Understand system operation, including DDC system control and optimizing routines (algorithms).
 5. Operate the workstation and peripherals.
 6. Log on and off the system.
 7. Access graphics, point reports, and logs.
 8. Adjust and change system set points, time schedules, and holiday schedules.
 9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
 10. Understand system drawings, and Operation and Maintenance manual.
 11. Understand the job layout and location of control components.
 12. Access data from DDC controllers.
 13. Operate portable operators terminals.

END OF SECTION 230923

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SECTION 230934
VARIABLE-FREQUENCY MOTOR CONTROLLERS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.
- B. Overcurrent protective devices for motor controllers, including overload relays.

1.02 RELATED REQUIREMENTS

- A. Section 230529 - Hangers and Supports for HVAC Piping and Equipment.
- B. Section 230553 - Identification for HVAC Piping and Equipment: Identification products and requirements.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
- D. Section 262813 - Fuses.
- E. Section 284621.13 - Existing Fire Alarm System: For interface with variable-frequency motor controllers.

1.03 REFERENCE STANDARDS

- A. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- B. NEMA IA 10039 - Control Circuit and Pilot Devices; 2025.
- C. NEMA IS 10034 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems; 2022 (Reapproved 2025).
- D. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems; 2005.
- E. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work to provide motor controllers suitable for use with actual motors to be installed.
 - 2. Coordinate work to provide controllers and associated wiring suitable for interface with control devices to be installed.
 - 3. Coordinate arrangement with dimensions and clearance requirements of actual equipment to be installed.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with conductors to be installed.
 - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of controllers and adjacent equipment with required clearances indicated.
 - 2. Include wiring diagrams showing factory and field connections.
 - 3. Identify mounting conditions required for equipment seismic qualification.
- D. Derating Calculations: Indicate ratings adjusted for applicable service conditions.
- E. Specimen Warranty: Submit sample of manufacturer's warranty.
- F. Manufacturer qualification statement.
- G. Installer qualification statement.
- H. Maintenance contractor qualification statement, if different entity from installer.
- I. Manufacturer's certification that products meet or exceed specified requirements.
- J. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- K. Source quality control test reports.
- L. Manufacturer's detailed field testing procedures.
- M. Field quality control test reports.
- N. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - 1. Include contact information for entity providing contract maintenance and trouble call-back service.
- O. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- P. Maintenance contracts.
- Q. Project Record Documents: Record actual installed locations of controllers and final equipment settings.
 - 1. Include nameplate data of actual installed motors and associated overload relay selections and settings.
 - 2. Motor Circuit Protectors: Include magnetic instantaneous trip settings.
- R. Maintenance Materials: Furnish following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Electronic Trip Circuit Breakers: Provide one portable test set.
 - 3. Indicating Lights: Two of each different type.
 - 4. Air Filters: Two of each different type.
 - 5. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
 - 1. Authorized service facilities located within 200 miles of project site.
- C. Installer Qualifications: Company with minimum three years documented experience with variable-frequency motor control systems of similar size, type, and complexity; manufacturer's authorized installer.
- D. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum 18 month manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB
- B. Danfoss
- C. Allen-Bradley
- D. Square D.
- E. Substitutions: See Section 016000 - Product Requirements.
- F. Source Limitations: Furnish variable-frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

2.02 VARIABLE-FREQUENCY MOTOR CONTROLLERS

- A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.
- B. Provide products listed, classified, and labeled as suitable for purpose intended.
- C. General Requirements for VFCs:
 - 1. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 - 2. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.
- D. Application: Constant torque and variable torque.
- E. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with

integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1 motors.
2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- F. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- G. Output Rating: Three phase; 10 to 66 Hz, with torque constant as speed changes; maximum voltage equals input voltage.
- H. Unit Operating Requirements:
 1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 5. Minimum Displacement Primary-Side Power Factor: 96percent under any load or speed condition.
 6. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
 7. Humidity Rating: Less than 95 percent (noncondensing).
 8. Altitude Rating: Not exceeding 3300 feet.
 9. Vibration Withstand: Comply with NEMA ICS 61800-2.
 10. Speed Regulation: Plus or minus 10 percent.
 11. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
 12. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- I. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.
- J. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
 1. Signal: Electrical.
- K. Internal Adjustability Capabilities:
 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 0.1 to 999.9 seconds.
 4. Deceleration: 0.1 to 999.9 seconds.
 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- L. Self-Protection and Reliability Features:
 1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
 2. Surge Suppression: Field-mounted surge suppressors complying with Section 26-4313 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
 3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 4. Under- and overvoltage trips.

5. Inverter overcurrent trips.
 6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
 7. Critical frequency rejection, with three selectable, adjustable deadbands.
 8. Instantaneous line-to-line and line-to-ground overcurrent trips.
 9. Loss-of-phase protection.
 10. Reverse-phase protection.
 11. Short-circuit protection.
 12. Motor-overtemperature fault.
- M. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- N. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- O. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- P. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- Q. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- R. Integral Input Disconnecting Means and OCPD: UL 489, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
 2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
 3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
 4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
 5. Alarm contact that operates only when circuit breaker has tripped.

2.03 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 2. Security Access: Provide electronic security access to controls through identification and password with at least one level of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
 2. Running log of total power versus time.
 3. Total run time.
 4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: either 0- to 10-V dc or 4- to 20-mA dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 3. Output Signal Interface: A minimum of one programmable analog output signal(s) either 0- to 10-V dc or 4- to 20-mA dc, which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).

- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

- 1. Number of Loops: One.

2.04 BYPASS SYSTEMS

- A. Bypass Operation: Manually transfers motor between power converter output and bypass circuit. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
- B. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor, and retransfer shall only be allowed with the motor at zero speed.
- C. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
 - 1. Bypass Contactor: Load-break, NEMA-rated contactor.
 - 2. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
 - 3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- D. Bypass Contactor Configuration: Full-voltage (across-the-line).
 - 1. NORMAL/BYPASS selector switch.
 - 2. HAND/OFF/AUTO selector switch.
 - 3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
 - 4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 100 VA.
 - b. Overload Relays: NEMA ICS 2.

2.05 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 4X.
 - 3. Kitchen and/or Wash-Down Areas: Type 4X, stainless steel.
 - 4. Other Wet or Damp Indoor Locations: Type 4.

5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.06 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
 1. Push Buttons: Covered.
 2. Pilot Lights: Push to test.
 3. Selector Switches: Rotary type.
- B. Reversible NC/NO bypass contactor auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. 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.
 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
- E. Supplemental Digital Meters:
 1. Elapsed-time meter.
 2. Kilowatt meter.
 3. Kilowatt-hour meter.
- F. Variable-Frequency Motor Controller:
 1. Configuration: Packaged controller, nonbypass.
 2. Power Conversion System: Diode-based, 6-pulse type.
 3. Control Method: Vector; open-loop, without feedback.
 4. Filtering: Provide input/line reactor and output/load reactor.

2.07 OVERCURRENT PROTECTIVE DEVICES

- A. Overload Relays:
 1. Provide overload relays and, where applicable, associated current elements/heaters selected for actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
 2. Comply with NEMA ICS 2.
 3. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
 4. Trip-free operation.
 5. Visible trip indication.
 6. Resettable:
 - a. Employ manual reset unless otherwise indicated.
 - b. Do not employ automatic reset with two-wire control.

2.08 ACCESSORIES

- A. Auxiliary Contacts:
 1. Comply with NEMA IA 10039.

2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each bypass motor starter, minimum.
- B. Pilot Devices:
 1. Comply with NEMA IA 10039; heavy-duty type.
 2. Nominal Size: 30 mm.
 3. Pushbuttons: Unless otherwise indicated, provide momentary, nonilluminated type with flush button operator; normally open or normally closed as indicated or as required.
 4. Selector Switches: Unless otherwise indicated, provide maintained, nonilluminated type with knob operator; number of switch positions as indicated or as required.
 5. Indicating Lights: Push-to-test type unless otherwise indicated.
 6. Provide LED lamp source for indicating lights and illuminated devices.
- C. Control and Timing Relays:
 1. Comply with NEMA IA 10039.
 2. Provide number and type of relays indicated or required to perform necessary functions.
 3. Timing Relays: Electronic.
- D. Control Power Transformers:
 1. Size to accommodate burden of contactor coil(s) and connected auxiliary devices.
 2. Include primary and secondary fuses.
- E. Control Terminal Blocks: Include 25 percent spare terminals.

2.09 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Factory test controllers in accordance with NEMA ICS 61800-2.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings of controllers are consistent with indicated requirements.
- C. Verify that mounting surfaces are ready to accept controllers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install in accordance with NEMA IS 10034 and manufacturer's instructions.
- C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 230529.
- F. Install controllers plumb and level.
- G. Provide grounding and bonding in accordance with Section 260526.
- H. Install field-installed devices, components, and accessories.
- I. Provide fuses complying with Section 262813 for fusible switches as indicated.

- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.
- L. Identify controllers in accordance with Section 230553.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide services of manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.17. Insulation-resistance test on control wiring listed as optional is not required.
- E. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- F. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1. Tests listed as optional are not required.
- G. Packaged Controllers with Bypass: Test for proper operation in both drive and bypass modes.
- H. Test for proper interface with other systems.
- I. Correct deficiencies and replace damaged or defective controllers or associated components.
- J. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of controllers and associated devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.

3.07 PROTECTION

- A. Protect installed controllers from subsequent construction operations.

3.08 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner a proposal as alternate to base bid, a separate maintenance contract for service and maintenance of controllers for two years from date of Substantial Completion; Include complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with detailed schedule.
- C. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.
- D. Provide trouble call-back service upon notification by Owner:
 - 1. Provide on-site response within 4 hours of notification.
 - 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

END OF SECTION 230934

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**SECTION 231123
FACILITY NATURAL-GAS PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.02 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting.
- B. Section 230516 - Expansion Fittings and Loops for HVAC Piping.
- C. Section 230553 - Identification for HVAC Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2019.
- B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- D. ASME B31.1 - Power Piping; 2024.
- E. ASME B31.9 - Building Services Piping; 2025.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- G. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.
- H. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
- I. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- D. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.

- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Threaded or welded to ASME B31.1.

2.02 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches and Under:
 - 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
- B. Flanges for Pipe Size Over 1 Inch:
 - 1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2.03 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 - 4. Vertical Pipe Support: Steel riser clamp.
 - 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.

2.04 BALL VALVES

- A. Construction, 2 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel ball, full port, Teflon seats and stuffing box ring, blowout proof stem, lever handle with balancing stops, threaded or welded ends with union.

2.05 PLUG VALVES

- A. Construction 2-1/2 Inches and Larger: MSS SP-78, 175 psi CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.06 STRAINERS

- A. Size 2 inch and Under:
 - 1. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- B. Size 2-1/2 inch to 4 inch:
 - 1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

2.07 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

- A. Compliance Requirements:
 - 1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
- B. Materials in Contact With Gas:
 - 1. Housing: Aluminum, steel (free of non-ferrous metals).
 - 2. Seals and Diaphragms: NBR-based rubber.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 230516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- I. Install valves with stems upright or horizontal, not inverted.
- J. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- K. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 6. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.04 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.

- B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Provide plug valves in natural gas systems for shut-off service.

3.05 SCHEDULES

- A. Pipe Hanger Spacing:
 - 1. Metal Piping:
 - a. Pipe Size: 1/2 inches to 1-1/4 inches:
 - 1) Maximum Hanger Spacing: 6.5 ft.
 - 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe Size: 1-1/2 inches to 2 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION 231123

**SECTION 232113
HYDRONIC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Equipment drains and overflows.
- D. Pipe hangers and supports.
- E. Unions, flanges, mechanical couplings, and dielectric connections.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 230516 - Expansion Fittings and Loops for HVAC Piping.
- C. Section 230523 - General-Duty Valves for HVAC Piping.
- D. Section 230553 - Identification for HVAC Piping and Equipment.
- E. Section 230719 - HVAC Piping Insulation.
- F. Section 232114 - Hydronic Specialties.
- G. Section 232500 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

- A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- D. ASME B31.9 - Building Services Piping; 2025.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- F. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.
- G. ASTM B32 - Standard Specification for Solder Metal; 2020.
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- J. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- K. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe; 2000.
- L. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of all piping with size, location and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Provide manufacturers catalog information.
 - 3. Indicate valve data and ratings.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Project Record Documents: Record actual locations of valves.
- E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 - 3. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges or unions to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
- D. Valves: Provide valves where indicated:
 - 1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.

2.02 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:

1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D10.12M/D10.12 welded.
2. Threaded Joints: ASME B16.3, malleable iron fittings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L, drawn temper, using one of the following joint types:
 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

2.03 BYPASS CHEMICAL FEEDER AND FILTER

- A. Description: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, replaceable sock filter and drain valves.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

2.04 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

2.05 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58. Refer to Specification Section 230529.

2.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe of 2 Inches and Less:
 1. Ferrous Piping: 150 psi brass or malleable iron, threaded.
 2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches and Greater:
 1. Ferrous Piping: 150 psig forged steel, slip-on.
 2. Copper Piping: Bronze.
 3. Gaskets: 1/16 inch thick, preformed neoprene.
- C. Dielectric Connections:
 1. Flanges:
 - a. Dielectric flanges with same pressure ratings as standard flanges.
 - b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - c. Dry insulation barrier able to withstand 600-volt breakdown test.
 - d. Construct of galvanized steel with threaded end connections to match connecting piping.
 - e. Suitable for the required operating pressures and temperatures.
 2. Unions:
 - a. 1/2 to 1 Inches: Brass solder to galvanized FPT.
 - b. 1/2 to 2 Inches: Brass solder to galvanized FPT.

- c. 1/2 to 1 Inches: Brass to galvanized FPT or FIP (Female Iron Pipe).
- d. 3/4 to 1/2 Inch Reducer: Brass solder to galvanized FPT.
- e. Service: 250 psi, minus 20 to 180 deg F.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment using jointing system specified.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems. See Section 232500 for additional requirements.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water to ASME B31.9 requirements.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interference with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls, and floors.
- G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
- H. Slope piping and arrange to drain at low points.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 230516.
 - 1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
 - 2. Use flexible couplings in expansion loops.
- J. Pipe Hangers and Supports:
 - 1. Refer to Specification Section 230529.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 230719.
- L. Install valves with stems upright or horizontal, not inverted.

3.03 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 4. 2-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 5. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 6. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- B. Hanger Spacing for Steel Piping.
 - 1. 1/2 Inch, 3/4 Inch, and 1 Inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.

2. 1-1/4 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2 Inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.

END OF SECTION 232113

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**SECTION 232114
HYDRONIC SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Suction diffusers.
- F. Pump connectors.
- G. Combination pump discharge valves.
- H. Pressure-temperature test plugs.
- I. Balancing valves.
- J. Pressure reducing valves.

1.02 RELATED REQUIREMENTS

- A. Section 221119 - Domestic Water Piping Specialties: Backflow preventers.
- B. Section 232113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.
- D. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded; 2021.
- E. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Designer's qualification statement.
- E. Manufacturer's qualification statement.
- F. Maintenance Contract.

- G. Project Record Documents: Record actual locations of flow controls.
- H. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 EXPANSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc.
 - 2. Armstrong Pumps, Inc.
 - 3. Bell & Gossett, a brand of Xylem, Inc.
 - 4. Watts.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible EPDM diaphragm or bladder seal factory precharged to 12 psi, and steel support stand.
- C. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced-pressure-principle backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.
 - 1. See Section 221119 for backflow preventer specifications.
- D. Accessories: Provide air-charging fitting, bulls eye sight glass, pressure gauge, and tank drain ball valve.

2.02 AIR VENTS

- A. Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- B. Maximum Fluid Pressure: 150 psi.
- C. Maximum Fluid Temperature: 250 degrees F.

2.03 AIR SEPARATORS

- A. Coalescing Air/Dirt Separators:
 - 1. Manufacturers:
 - a. Armstrong International, Inc
 - b. Bell & Gossett, a brand of Xylem, Inc
 - c. Spirotherm, Inc
 - d. Caleffi
 - e. Substitutions: See Section 016000 - Product Requirements.

2. Tank: Fabricated steel tank; tested and stamped in accordance with ASME BPVC-VIII-1 for maximum fluid service subject to application requirements and manufacturer's standard maximum operating conditions.
3. Coalescing Medium: Provide structured copper or stainless steel medium filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location.
4. Air Vent: Integral float actuated air vent at top fitting of tank rated at 150 psi, threaded to top of separator.
5. End Connections: Class 150 flanged for 2-1/2 inch and larger otherwise threaded.
6. Blowdown Connection: Threaded.
7. Size: Match system flow capacity.
8. Maximum Fluid Service Pressure: 150 psi.
9. Maximum Fluid Service Temperature: 250 degrees F.

2.04 STRAINERS

- A. Size 2 inch and Under:
 1. Provide threaded or sweat brass or iron body for up to 175 psi working pressure, Y-pattern strainer with 1/32 inch stainless steel perforated screen.
- B. Size 2-1/2 inch to 4 inch:
 1. Provide flanged iron body for up to 175 psi working pressure, up to 250 degrees F working temperature, Y-pattern strainer with 1/16 inch or 3/64 inch stainless steel perforated screen.

2.05 SUCTION DIFFUSERS

- A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh startup screen, and permanent magnet located in flow stream and removable for cleaning.
- B. Class 125:
 1. Horizontally or vertically mounted angle-pattern fitting with integral-cast vanes, fine particle mesh screen and magnetic drain plugs for particle removal without disassembly.
 2. Maximum Operating Service: 175 psi and 300 degrees F.
 3. Sizes, Material, and Connection:

2.06 PUMP CONNECTORS

- A. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
 1. Maximum Operating Service: 150 psi at 120 degrees F.
 2. Accommodate the Following:
 - a. Angular Rotation: 15 degrees.
 - b. Force developed by 1.5 times specified maximum allowable operating pressure.
 3. End Connections: Same as specified for pipe jointing.
 4. Provide necessary accessories including, but not limited to, swivel joints.

2.07 COMBINATION PUMP DISCHARGE VALVES

- A. Class 125:

1. Maximum Service Operation: 175 psi at 125 degrees F.
- B. Triple-Duty Globe Type: Flanged cast-iron angle pattern body with bolt-on bonnet, position indicator, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, metering connectors, flow shutoff mechanism, and adjustable flow handle.

2.08 PRESSURE-TEMPERATURE TEST PLUGS

- A. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.
- B. Application: Use extended length plugs to clear insulated piping.

2.09 PRESSURE REDUCING VALVES

- A. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 232113.
- B. Materials of Construction:
 1. Valve Body: Constructed of bronze, cast iron, brass, or iron.
 2. Internal Components: Construct of stainless steel or brass and engineered plastics or composition material.
- C. Connections: Same as specified for pipe jointing.
- D. Provide integral check valve and strainer.
- E. Maximum Inlet Pressure: 400 psi.
- F. Maximum Fluid Temperature: 180 degrees F.
- G. Adjustable Pressure Range.

2.10 PRESSURE INDEPENDENT VALVES

- A. Size 2 inch and Smaller:
 1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
 2. Metal construction materials consist of bronze or brass.
 3. Non-metal construction materials consist of Teflon or EPDM.
- B. Size 2-1/2 inch and Larger:
 1. Provide ball, globe, or butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged or weld end connections.
 2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
 3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, NORYL, or engineered resin.

2.11 AUTOMATIC FLOW LIMITING VALVES

- A. Size 1/2 inch to 14 inch:
 1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
 2. Metal construction materials consist of bronze or brass.
 3. Non-metal construction materials consist of Teflon or EPDM.
- B. Size 2-1/2 inch to 24 inch:
 1. Comply with ASME B16.5.

2. Class: 150.
3. Provide ball, globe, butterfly, or wafer style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged or weld end connections.
4. Valve body construction materials consist of cast iron, carbon steel, ductile iron, or gray iron.
5. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, NORYL, or engineered resin.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install specialties and equipment in accordance with manufacturer's instructions.
- B. Provide manual air vents at system high points and as indicated.
- C. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- D. Provide valved drain and hose connection on strainer blowdown connection.
- E. Provide pump suction fitting on suction side of base-mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.
- F. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.
- G. Support pump fittings with floor-mounted pipe and flange supports.
- H. Provide radiator valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil units.
- I. Provide radiator balancing valves on water outlet from terminal heating units such as radiation, unit heaters, and fan coil units.
- J. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- K. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- L. Pipe relief valve outlet to nearest floor drain.
- M. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

3.02 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.

3.03 CLEANING

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

3.04 MAINTENANCE

- A. See Section 017000 - Execution Requirements for additional requirements relating to maintenance service.
- B. Provide service and maintenance of glycol system for one year from date of Substantial Completion at no extra charge to Owner.
- C. Perform monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Report findings in detail in writing, including analysis and amounts of glycol or water added.

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- D. Explain corrective actions to Owner's maintenance personnel in person.

END OF SECTION 232114

**SECTION 232123
HYDRONIC PUMPS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. In-line pumps.
- B. End-suction pumps.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 230513 - Common Motor Requirements for HVAC Equipment.
- C. Section 230716 - HVAC Equipment Insulation.
- D. Section 230719 - HVAC Piping Insulation.
- E. Section 230923 - Direct-Digital Control System for HVAC.
- F. Section 230934 - Variable-Frequency Motor Controllers for HVAC.
- G. Section 232113 - Hydronic Piping.
- H. Section 232114 - Hydronic Specialties.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
- D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Armstrong Fluid Technology, Inc
- B. Bell & Gossett, a Xylem Inc. brand
- C. Grundfos Pumps Corporation
- D. Substitutions: See Section 016000 - Product Requirements.

2.02 GENERAL

- A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Electrical Requirements:

1. Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.
2. Variable Frequency Drives (VFDs): Provide in accordance with Section 230934, except for integral-VFDs.

2.03 IN-LINE PUMPS

- A. Closed-Coupled, Single-Stage Pump: Vertical pump with radially- or horizontally-split casing; rated for discharge pressures up to 175 psi.
- B. Casing: Cast iron with seal flush connection, threaded suction, and discharge ports with gauge port and drain plug.
- C. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
- D. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.
- E. Seal: Mechanical seal, 225 degrees F maximum continuous duty temperature.
- F. Electrical:
 1. Motor: 1,750 rpm, open drip-proof (ODP); see Section 230513.
 2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.04 END-SUCTION PUMPS

- A. Close-Coupled Pump: Base-mounted, long-coupled, single-stage pump with horizontal shaft and radially- or horizontally-split casing rated for discharge pressures up to 360 psi.
- B. Casing: Cast iron or ductile iron with renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction, and discharge flanged connections with gauge ports.
- C. Impeller: Stainless steel, balanced, fully enclosed, keyed to shaft.
- D. Bearings: Oil lubricated roller or ball bearings.
- E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.
- F. Drive: Flexible coupling with coupling guard.
- G. Baseplate: Cast iron or fabricated steel with integral drain rim.
- H. Electrical:
 1. Motor: 1,750 rpm, total-enclosed, fan-cooled (TEFC); see Section 230513.
 2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
- C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

- D. Provide line sized shut-off valve and strainer on pump suction, and line sized combination pump discharge valve on pump discharge.
- E. Provide air cock and drain connection on horizontal pump casings.
- F. Provide drains for bases and seals, piped to and discharging into floor drains.
- G. Check, align, and certify alignment of base-mounted pumps prior to start-up.
- H. Install close-coupled and base-mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. See Section 033000.
- I. Lubricate pumps before start-up.
- J. Provide side-stream filtration system for closed loop systems. Install across pump with flow from pump discharge to pump suction from pump tapings.
- K. Controls: Interface each pump starter or VFD with HVAC controller; see Section 230923.

END OF SECTION 232123

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**SECTION 232500
HVAC WATER TREATMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Materials.
 - 1. System cleaner.
 - 2. Closed system treatment (water).
- B. Test equipment.

1.02 RELATED REQUIREMENTS

- A. Section 011000 - Summary
- B. Section 016000 - Product Requirements
- C. Section 230913 - Instrumentation and Control Devices for HVAC.
- D. Section 232113 - Hydronic Piping.
- E. Section 232114 - Hydronic Specialties.
- F. Section 260583 - Wiring Connections

1.03 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide; Current Edition.
- B. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.
- E. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.
- F. Certificate: Submit certificate of compliance from Authority Having Jurisdiction indicating approval of chemicals and their proposed disposal.
- G. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
- H. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Sufficient chemicals for treatment and testing during required maintenance period.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, and approved by manufacturer.

PART 2 PRODUCTS

2.01 HVAC WATER TREATMENT CONTRACTORS

- A. HVAC water treatment contractors shall be limited to the following:
 - 1. Environmental Water Engineering
- B. Substitutions: See Section 016000 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.
- B. Comply with UL (DIR) requirements.
- C. Perform work in accordance with local health department regulations.
- D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.03 MATERIALS

- A. System Cleaner:
 - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.
 - 2. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate).
- B. Closed System Treatment (Water):
 - 1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
 - 2. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
 - 3. Conductivity enhancers; phosphates or phosphonates.

2.04 TEST EQUIPMENT

- A. Provide white enamel test cabinet with local and fluorescent light, capable of accommodating 4 - 10 ml zeroing titrating burettes and associated reagents.
- B. Provide the following test kits:
 - 1. Alkalinity titration test kit.
 - 2. Chloride titration test kit.
 - 3. Sulfite titration test kit.
 - 4. Total hardness titration test kit.
 - 5. Low phosphate test kit.
 - 6. Conductivity bridge, range 0 - 10,000 micro-ohms.
 - 7. Creosol red pH slide complete with reagent.
 - 8. Portable electronic conductivity meter.
 - 9. High nitrite test kit.

PART 3 EXECUTION

3.01 WATER ANALYSIS

- 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 appropriate water characteristics.
- B. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

3.02 PREPARATION

- A. Place terminal control valves in open position during cleaning.
- B. Verify that electric power is available and of the correct characteristics.

3.03 CLEANING SEQUENCE

- A. Concentration:
 - 1. As recommended by manufacturer.
- B. Hot Water Heating Systems:
 - 1. Hot Water System Flush: Completely drain system and clean all strainer screens. Then 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 48 hours, cleaning strainers after 24 hours. After 48 hours drain, clean strainer screens, and refill with fresh water and add chemical treatment.
 - 2. Check all strainers at all existing equipment. Refer to attached drawings at the end of this specification section for existing equipment locations at Orchard Center High School and Hollywood Elementary.
- C. Remove, clean, and replace strainer screens.
- D. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.04 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install chemical-application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units, so controls and devices that require servicing are accessible. Anchor floor-mounting accessories to substrate.
- C. Install water-testing equipment on wall near water-chemical-application equipment.
- D. Bypass Feeders: Install bypass feeders in all closed hydronic systems and equip with the following:
 - 1. Install bypass feeder in a bypass circuit around circulating pumps unless indicated otherwise on Drawings.
 - 2. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
 - 3. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below the feeder inlet.
 - 4. Install a swing check on the inlet after the isolation valve.
- E. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- F. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.05 CLOSED SYSTEM TREATMENT

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise. Refer to Specification Section 232113 for information on bypass feeder.
- B. Introduce closed system treatment through bypass feeder when required or indicated by test.

3.06 CLOSEOUT ACTIVITIES

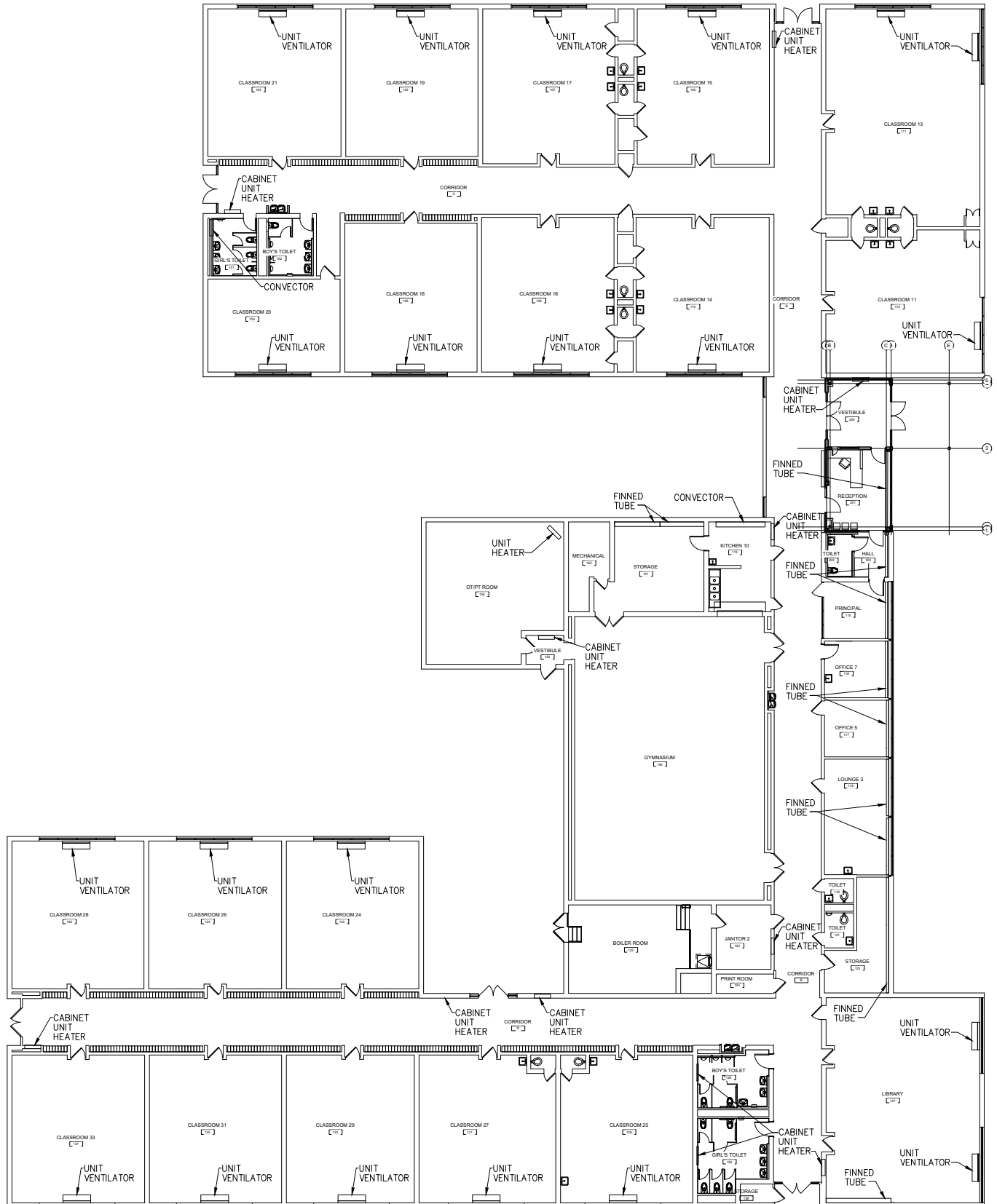
- A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
 - 1. Provide minimum of two hours of instruction for two people.
 - 2. Have operation and maintenance data prepared and available for review during training.
 - 3. Conduct training using actual equipment after treated system has been put into full operation.

3.07 MAINTENANCE

- A. See Section 017000 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above, to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:
 - 1. Initial water analysis and HVAC water-treatment recommendations.
 - 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 - 3. Periodic field service and consultation.
 - 4. Customer report charts and log sheets.
 - 5. Laboratory technical analysis.
 - 6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

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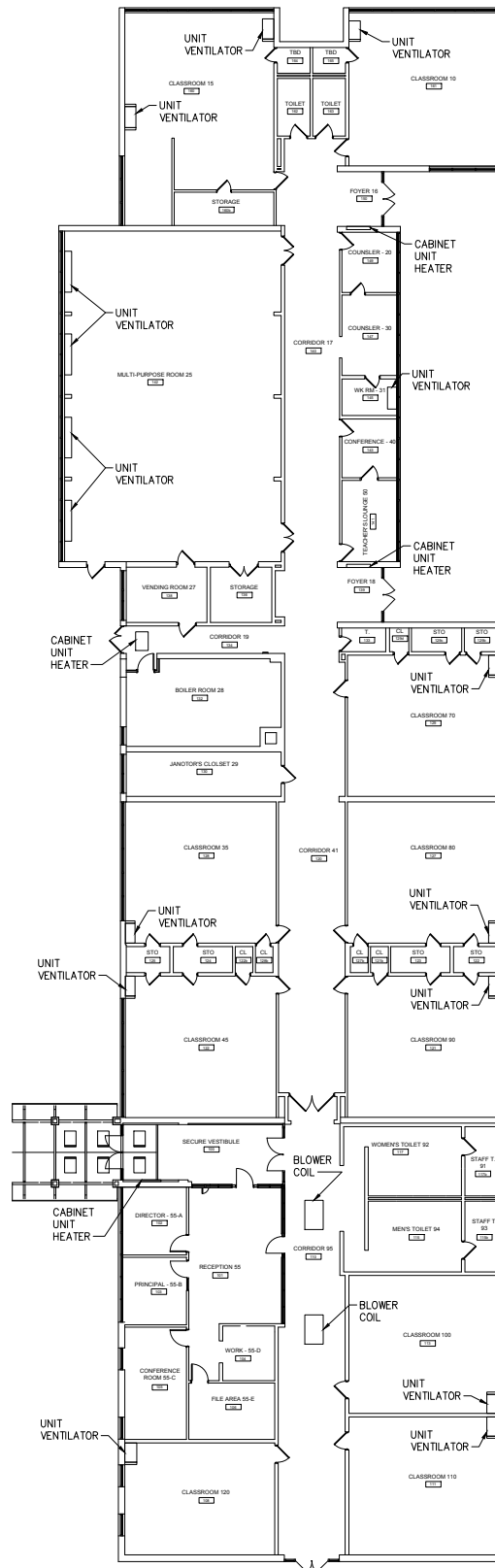


HOLLYWOOD ELEMENTARY HYDRONIC EQUIPMENT PLAN
NOT TO SCALE



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ORCHARD CENTER HIGH SCHOOL HYDRONIC EQUIPMENT PLAN
NOT TO SCALE



END OF SECTION 232500

**SECTION 233100
HVAC DUCTS AND CASINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ducts.
- B. Air plenums and casings.

1.02 RELATED REQUIREMENTS

- A. Section 230713 - Duct Insulation.
- B. Section 233300 - Air Duct Accessories.
- C. Section 233600 - Air Terminal Units.
- D. Section 233700 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- D. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- E. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
- F. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- G. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- I. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- K. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for duct materials.
- C. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration.
- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).
- E. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.
- C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 233319.
- D. Duct Fabrication Requirements:
 - 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
 - 2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
 - 3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
 - 4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
 - 5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
 - 6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
 - 7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.02 METAL DUCTS

- A. Material Requirements:
 - 1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Rectangular Metal Duct:
 - 1. Rectangular Single Wall: Rectangular, longitudinal lock seam duct with galvanized steel wall.
- C. Connectors, Fittings, Sealants, and Miscellaneous:
 - 1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.

2. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - b. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
3. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
4. Hanger Fasteners: Attach hangers to structure using appropriate fasteners as follows:
 - a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - b. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - c. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - d. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - e. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

2.03 AIR PLENUMS AND CASINGS

- A. Fabricate in accordance with SMACNA (DCS) for indicated operating pressures indicated.
- B. Minimum Fabrication Requirements:
 1. Fabricate plenum or casing with reinforcing turned inward.
 2. Provide 16-gauge, 0.059-inch sheet steel back facing and 22-gauge, 0.029-inch perforated sheet steel front facing with 3/32 inch diameter holes on 5/32 inch centers.
 3. Construct panels 3 inches thick, packed with 4.5 pcf minimum glass fiber insulation media, on inverted channel of 16-gauge, 0.059-inch sheet steel.
 4. Mount floor-mounted plenum or casings on 4-inch high concrete curbs. At floor, rivet panels on 8-inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch expanded metal mesh supported at 12-inch centers, turned up 12 inches at sides with sheet metal shields.
- C. Access Doors:
 1. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
 2. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
 3. Provide clear wire glass observation ports, minimum 6 by 6 inch size.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. Comply with safety standards NFPA 90A and NFPA 90B.
- D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- F. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

- G. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
- H. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- I. Use double nuts and lock washers on threaded rod supports.
- J. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
- K. Louver Fit-out:
 - 1. Provide blank-out panels sealing available area of wall-mounted exterior-faced louver when connected ductwork is smaller than actual louver free area, and duct outlet is smaller than the louver frame.
 - 2. Use the same duct material painted black on the exterior side, then seal louver frame and duct.
- L. Plenums and Casings:
 - 1. Mount floor-mounted casings on 4 inch high concrete curbs.
 - 2. At floor, rivet panels on 8 inch centers to angles.
- M. Duct Accessories, Inlets, and Outlets: Interconnect as indicated in Sections 233300 and 233700.
- N. Duct Insulation: Provide duct insulation. See Section 230713.

3.02 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.
- B. Clean duct systems with high-power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters or bypass during cleaning. Provide adequate access to the ductwork for cleaning purposes.

END OF SECTION 233100

**SECTION 233300
AIR DUCT ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Duct access doors.
- D. Duct test holes.
- E. Flexible duct connectors.
- F. Volume control dampers.
- G. Miscellaneous Products:
 - 1. Damper operators.
 - 2. Internal strut end plugs.
 - 3. Duct opening closure film.

1.02 RELATED REQUIREMENTS

- A. Section 233100 - HVAC Ducts and Casings.
- B. Section 230923 - Direct Digital Control System for HVAC
- C. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2025).
- B. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2025).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- E. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

2.02 BACKDRAFT DAMPERS - METAL

- A. Backdraft Dampers, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
- B. Multi-Blade, Parallel Action Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.
- C. Motorized damper actuators shall be furnished by Temperature Controls Contractor. Refer to Specifications Section 230923 - Direct-Digital Control System for HVAC.

2.03 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick-fastening locking devices. For insulated ducts, install minimum 1-inch thick insulation with sheet metal cover.
 - 1. Less Than 12 inches Square: Secure with sash locks.
 - 2. Up to 18 inches Square: Provide two hinges and two sash locks.
 - 3. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.

2.04 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.05 FLEXIBLE DUCT CONNECTORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
 - a. Net Fabric Width: Approximately 2 inches wide.
 - 2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.
- C. Maximum Installed Length: 14 inch.

2.06 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Single Blade Dampers:
 - 1. Fabricate for duct sizes up to 6 by 30 inch.
 - 2. Blade: 24 gauge, 0.0239 inch, minimum.

- C. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inches. Assemble center- and edge-crimped blades in prime-coated or galvanized-channel frame with suitable hardware.
- D. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
- E. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.07 MISCELLANEOUS PRODUCTS

- A. Damper Operators: Provide electric operators; see Sections 230913 and 230923.
- B. Damper position switch; see Sections 230913 and 230923.
- C. Internal Strut End Plugs: Combination end-mounting and sealing plugs for metal conduit used as internal reinforcement struts for metal ducts; plug crimped inside conduit with outside gasketed washer seal.
- D. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
 - 1. Thickness: 2 mils.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 233100 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch size access door for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- F. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- G. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.

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- H. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 233300

SECTION 233423
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Inline Cabinet Fans.

1.02 RELATED REQUIREMENTS

- A. Section 233300 - Air Duct Accessories.
- B. Section 230923 - Direct Digital Control System for HVAC

1.03 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 - Standards Handbook; 2025.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.
- E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate fan roof curbs and service utilities installation according to fan size.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are completed in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Manufacturer's Instructions: Indicate installation instructions.
- D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.07 FIELD CONDITIONS

- A. Permanent ventilators may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Greenheck Fan Corporation
- B. Loren Cook Company
- C. PennBarry, Division of Air System Components
- D. Substitutions: See Section 016000 - Product Requirements.

2.02 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204.
- B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- D. Fabrication: Comply with AMCA 99.
- E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.03 INLINE CABINET FANS

- A. Centrifugal Fan Unit: direct driven ECM motor with galvanized steel housing lined with acoustic insulation, resiliently mounted motor, gravity backdraft damper in discharge.
- B. Disconnect Switch: Furnished by E.C..
- C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is reached with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Hung Cabinet Fans:
 - 1. Install fans with resilient mountings and flexible electrical leads, see Section 230548.
 - 2. Install flexible connections between fan and ductwork; see Section 233300. Ensure metal bands of connectors are parallel with minimum 1 inch flex between ductwork and fan while running.
- C. Provide sheaves required for final air balance.

END OF SECTION 233423

**SECTION 233700
AIR OUTLETS AND INLETS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Louvers
- B. Goosenecks.
- C. Gravity ventilators.

1.02 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting: Painting of ducts visible behind outlets and inlets.

1.03 REFERENCE STANDARDS

- A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.
- C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).
- D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2022.
- E. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- H. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.05 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.
- C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Greenheck.
- B. Loren Cook
- C. Carnes.
- D. Substitutions: See Section 016000 - Product Requirements.

2.02 LOUVERS

- A. Manufacturers:
 - 1. Ruskin Company.

2. Greenheck.
3. American Warming & Ventilating.
4. Substitutions: See Section 016000 - Product Requirements.
- B. Type: Fixed, extruded aluminum
 1. Horizontal Drainable-Blade Louver:
 2. Louver Depth: Refer to Schedule.
 3. Frame and Blade Nominal Thickness: Refer to Schedule.
 4. Mullion Type: Exposed.
 5. Louver Performance Ratings:
 - a. Free Area: Refer to Schedule.
 - b. Point of Beginning Water Penetration: Not less than 900 fpm.
 - c. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area velocity
 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- C. Louver Screens
 1. General: Provide screen at louvers indicated.
 - a. Screen Location for Fixed Louvers: Interior face.
 - b. Screening Type: Bird screening.
 2. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- D. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
 2. Finish: Same finish as louver frames to which louver screens are attached.
 3. Type: Non-rewirable, U-shaped frames.
- E. Louver Screening for Aluminum Louvers:
 1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.
 2. Thickness: 2 inches.
- F. Materials
 1. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
 2. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
 3. Galvanized-Steel Sheet: ASTM A653/A653M, G90 zinc coating, mill phosphatized.
 4. Fasteners: Use types and sizes to suit unit installation conditions.
 - a. Use hex-head or Phillips pan-head, tamper-resistant screws for exposed fasteners unless otherwise indicated.
 - b. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - c. For fastening galvanized steel, use hot-dip-galvanized-steel or 300 series stainless-steel fasteners.
 - d. For color-finished louvers, use fasteners with heads that match color of louvers.
 5. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to

the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.

6. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

G. Fabrication

1. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
2. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
 - a. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern where indicated.
 - b. Horizontal Mullions: Provide horizontal mullions at joints where indicated.
3. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
4. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
5. Include supports, anchorages, and accessories required for complete assembly.
6. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
 - a. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 - b. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades, so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
 - c. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
 - d. Exterior Corners: Prefabricated corner units with mitered blades with concealed close-fitting splices.
7. Provide subsills made of same material as louvers or extended sills for recessed louvers.

H. Aluminum Finishes

1. Finish louvers after assembly.
2. Color Kynar Finish: AAMA 611 or thicker.
 - a. Color: As selected by Architect from manufacturer's standard color chart.

2.03 GOOSENECKS

- A. Fabricate in accordance with of minimum 18 gauge, 0.0598 inch galvanized steel.
- B. Mount on minimum 12 inch high curb base where size exceeds 9 by 9 inch.

2.04 GRAVITY VENTILATORS

A. Hood Relief Gravity Ventilator:

1. Manufacturers:
 - a. Greenheck Fan Corporation.
 - b. Loren Cook Company.
 - c. Pennbarry.
 - d. American Warming and Ventilating.
 - e. Substitutions: See Section 016000 - Product Requirements.
2. General:
 - a. Low silhouette for relief applications with natural gravity or positive pressure system(s).
 - b. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
 - c. Suitable for non-ducted applications.
 - d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
3. Hood and Base:
 - a. Material: Aluminum.
 - b. Hood Construction: Precision formed, arched panels with interlocking seams.
 - c. Vertical End Panels: Fully locked into hood end panels.
 - d. Curb Cap: Pre-punched mounting holes for installation.
4. Birdscreen:
 - a. Fabricate in accordance with ASTM B221 (ASTM B221M).
 - b. Construction: 1/2 inch Galvanized mesh.
 - c. Horizontally mounted across hood intake area.
5. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from base or hinged open.
6. Options/Accessories:
 - a. Roof Curbs:
 - 1) Flat Roofs:
 - a) Welded, straight side curb with flashing flange and wood nailer.
 - 2) Mounted on roof with fan.
 - 3) Material: Aluminum.
 - 4) Insulation Thickness: 1 inch.
 - b. Provide extended base minimum 7 inch extension to base height making overall base 14 inches in height to prevent snow or moisture intake.
 - c. Curb Seal: Rubber seal between fan and roof curb.
 - d. Dampers:
 - 1) Type: Motorized.
 - 2) Factory designed to prevent outside air from entering back into building when fan is off.
 - 3) Balanced for minimal resistance to flow.
 - 4) Galvanized frames with pre-punched mounting holes.
 - e. Hood Insulation or Coating: Provide 1-inch fiberglass insulation lining to prevent condensation and reduce sound levels.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- D. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black, see Section 099123.

3.02 CLOSEOUT ACTIVITIES

- A. Demonstrate operational system to Owner's representative.
- B. Instruct Owner's representative to maintain system and use occupant controls or interfaces, as required.

3.03 PROTECTION

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

END OF SECTION 233700

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**SECTION 235100
BREECHINGS, CHIMNEYS, AND STACKS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Special gas venting.

1.02 RELATED REQUIREMENTS

- A. Section 230513 - Common Motor Requirements for HVAC Equipment.h
- B. Section 230716 - HVAC Equipment Insulation.
- C. Section 230719 - HVAC Piping Insulation.
- D. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. NFPA 31 - Standard for the Installation of Oil-Burning Equipment; 2024.
- B. NFPA 54 - National Fuel Gas Code; 2024.
- C. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; 2024.
- D. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2024.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- F. UL 1738 - Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV; Current Edition, Including All Revisions.

1.04 DEFINITIONS

- A. Breeching: Vent connector.
- B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
- C. Smoke Pipe: Round, single wall vent connector.
- D. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- E. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of boiler flue and combustion air vents with size, location and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

- C. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory-built units are used.
- D. Manufacturer's Instructions: Include installation instructions, and indicate assembly, support details, and connection requirements.
- E. Manufacturer's Certificate: Certify that refractory lined metal stacks meet or exceed specified requirements.
- F. Installer's qualification statement.

1.07 QUALITY ASSURANCE

- A. Designer Qualifications: Design stacks under direct supervision of a Professional Structural Engineer experienced in design of the type of work specified and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing the type of work specified in this section with documented experience, and approved by manufacturer.

PART 2 PRODUCTS

2.01 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

- A. Regulatory Requirements:
 - 1. Comply with applicable codes for installation of natural gas burning appliances and equipment.
 - 2. Comply with NFPA 31 for installation of oil burning appliances and equipment.
 - 3. Factory-built vents and chimneys used for venting natural draft appliances to comply with NFPA 211 and UL listed and labeled.
 - 4. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.02 SPECIAL GAS VENTING (CATEGORY II, III, AND IV)

- A. Polypropylene Postive Pressure Vent:
 - 1. Manufacturers:
 - a. Duravent
 - b. Centrotherm
 - c. Selkirk
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 2. The vent shall be of the single wall, factory-built type, designed for use in conjunction with Category II, or IV condensing gas fired appliances, condensing oil fired appliances or as specified by the heating equipment manufacturer.
 - 3. Maximum continuous flue gas temperature shall not exceed 230 degrees F.
 - 4. Vent shall be listed for a maximum positive pressure rating of 20" w.c.
 - 5. The vent system shall be continuous from the appliance's flue outlet to the vent termination outside the building. All systems components shall be UL/cUL listed and supplied by the same manufacturer.
 - 6. The vent shall be constructed from Flame Resistant Polypropylene, with a min. wall thickness according to manufacturer's written instructions.

7. All systems components such as vent supports, roof or wall penetrations, terminations, appliance connectors and drain fittings required to install the vent system shall be UL/cUL listed and provided by the vent manufacturer.
8. All systems components shall include a factory- installed gasket in their female-end to render the vent air and water tight when the male/female ends are pushed together as per manufacturer's instructions. Vent systems requiring field installed sealants or compounds shall not be acceptable.
9. Vent layout shall be designed and installed in compliance with manufacturer's installation instructions and all applicable local codes.
10. Design, fabricate, and install gastight to prevent products of combustion from leaking into building. Securely connect inner joints and seal in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 54
- C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- D. Rigidly support breechings from building structure with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12-foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size.
- E. Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.
- F. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
- G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- H. Coordinate installation of dampers, and induced draft fans. See Section 260583.
- I. Insulate breechings in accordance with Section 230716.
- J. Install vent dampers, locating close to draft hood collar, and secured to breeching.
- K. Assemble and install stack sections in accordance with NFPA 82, UL Listings, and industry practices. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.
- L. Level and plumb chimney and stacks.
- M. Clean breechings, chimneys, and stacks during installation, removing dust and debris.
- N. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.

END OF SECTION 235100

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**SECTION 235216
CONDENSING BOILERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured units.
- B. Boiler construction.
- C. Boiler trim.
- D. Fuel burning system.
- E. Factory installed controls.

1.02 RELATED REQUIREMENTS

- A. Section 232114 - Hydronic Specialties.
- B. Section 232123 - Hydronic Pumps.
- C. Section 232500 - HVAC Water Treatment.
- D. Section 235100 - Breechings, Chimneys, and Stacks.
- E. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code
- B. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- C. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2022.
- D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2025).
- F. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2025, with Errata.
- G. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.
- H. NFPA 54 - National Fuel Gas Code; 2024.
- I. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990, with Amendment (2018).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.

- B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.
- C. Manufacturer's Installation Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.
- D. Manufacturer's Factory Inspection Report: Submit boiler inspection prior to shipment.
- E. Manufacturer's Field Reports: Burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.
 - 1. Indicate compliance with specified performance and efficiency.
 - 2. Provide results of the following combustion tests:
 - a. Boiler firing rate.
 - b. Over fire draft.
 - c. Gas flow rate.
 - d. Heat input.
 - e. Burner manifold gas pressure.
 - f. Percent carbon monoxide.
 - g. Percent oxides of nitrogen.
 - h. Percent oxygen.
 - i. Flue gas temperature at outlet.
 - j. Ambient temperature.
 - k. Percent combustion efficiency.
 - l. Heat output.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide a five year warranty to include coverage for heat exchanger.

1.09 COORDINATION

- A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Natural Gas, for Indoor Applications:

1. Lochinvar LLC - FTX Series
 2. Aerco - Benchmark Series
 3. Thermal Solutions - Amp Series
 4. Substitutions: See Section 016000 - Product Requirements.
- B. It shall be the responsibility of the Contractor to ensure that any substituted equipment is equivalent in fit, form, and function to the specified equipment. This includes integration of boilers with temperature controls system.

2.02 MANUFACTURED UNITS

- A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.
- B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.03 BOILER CONSTRUCTION

- A. Description: Boiler shall be natural gas fired, fully condensing, and fire tube design. The boiler shall be factory-fabricated, factory-assembled, and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.
- B. Heat Exchanger: The heater exchanger shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The heat exchanger shall be constructed of a fully welded stainless steel and of fire tube design. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. Cast iron, aluminum, or condensing copper tube boilers will not be accepted.
- C. Efficiency: Boilers shall have an AHRI certified minimum thermal efficiency of 97 percent.
- D. Condensate Collection Basin: Fully welded stainless steel and shall include a stainless steel combustion analyzer test port.
- E. Pressure Vessel: The pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The pressure vessel shall be designed for a single-pass water flow to limit the water side pressure drop. The pressure vessel shall contain a volume of water no less than 12 gallons.
- F. Burner: Natural gas, forced draft single burner premix design. The burner shall be high temperature stainless steel with a woven Fecralloy outer covering to provide modulating firing rates. The burner shall be capable of the stated gas train turndown without loss of combustion efficiency.
- G. Blower: Boiler shall be equipped with a pulse width modulating blower system to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The burner firing sequence of operation shall include pre-purge, firing, modulation, and post-purge operation.
- H. Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project.
- I. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

- J. Gas Train: The boiler shall be supplied with a negative pressure regulation gas train and shall be capable of turndown as specified on Boiler Schedule on contract drawings.
- K. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- L. High Altitude: Boiler shall operate at altitudes up to 4,500 feet above sea level without additional parts or adjustments. High altitude operation shall be certified at a minimum of 4,500 feet above sea level by a third party organization. High altitude boilers shall be certified to 3,000 to 12,000 feet above sea level. The boilers shall carry a CSA certification for high altitude operation up to 12,000 feet.
- M. Casing:
 - 1. Jacket: Heavy gauge primed and painted steel jacket with snap-in closures.
 - 2. Control Compartment Enclosures: NEMA 250, Type 1A.
 - 3. If retaining second option in "Jacket" Subparagraph above, delete first subparagraph below.
 - 4. Insulation: Minimum ½ inch thick, mineral fiber insulation surrounding the heat exchanger.
 - 5. Combustion-Air Connections: Inlet and vent duct collars.
- N. Characteristics and Capacities:
 - 1. Heating Medium: Hot water.
 - 2. Design Water Pressure Rating: 160 psi working pressure.
 - 3. Safety Relief Valve Setting: 75 psig
 - 4. Minimum Water Flow Rate: 12 gpm
- O. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.
- P. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.
- Q. Required Directory Listings:
 - 1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
 - 2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.
- R. Provide adequate tapings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.
- S. Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.
- T. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, painted, or weather-proofed finish.

2.04 BOILER TRIM

- A. ASME rated pressure relief valve.: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.
- B. Pressure Gage: Minimum 3-1/2 inch diameter. Gage shall have normal operating pressure about 50 percent of full range.
- C. Drain Valves: Minimum NPS 3/4 or nozzle size with hose-end connection
- D. Flow switch.

- E. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.
- F. Temperature and pressure gauge.
- G. Pressure Switches:
 - 1. High gas pressure.
 - 2. Low gas pressure.
 - 3. Air pressure.
- H. Manual reset high limit.
- I. Condensate Neutralization Kit: Factory supplied condensate trap with condensate trip sensor, high capacity condensate receiver prefilled with appropriate medium.

2.05 FUEL BURNING SYSTEM

- A. Provide forced draft automatic burner or pulse combustion, integral to boiler, designed to burn natural gas, and maintain fuel-air ratios automatically.
 - 1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
 - 2. Forced Draft Design: Mixes combustion air and gas to achieve minimum 90 percent combustion efficiency.
 - 3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.
 - 4. Combustion Air Filter: Protects fuel burning system from debris.
- B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.
- C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.
- D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.06 FACTORY INSTALLED CONTROLS

- A. Option for internal or external (0-10) VDC control.
- B. Temperature Controls:
 - 1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.
 - 2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
 - 3. Low-fire start time delay relay.
- C. Electronic PI setpoint/modulation control system.
- D. Microprocessor-based, fuel/air mixing controls.
- E. Boiler controls shall feature a standard, factory installed multi-color graphic LCD screen display with navigation and including the following standard features
 - 1. Outdoor air reset: Boiler shall calculate the set point using a field installed, factory supplied outdoor sensor and an adjustable reset curve.
 - 2. Pump exercise: Boiler shall energize any pump it controls for an adjustable time if the associated pump has been off for a time period of 24 hours.
 - 3. Four pump control: Boiler shall have the ability to control the boiler pump, a system pump, a domestic hot water pump, and a domestic hot water recirculation pump.

4. Ramp delay: Boiler may be programmed to limit the firing rate based on six limits steps and six time intervals.
 5. Boost function: Boiler may be programmed to automatically increase the set point a fixed number of degrees (adjustable by installer) if the setpoint has been continuously active for a set period of time (time adjustable by installer). This process will continue until the space heating demand ends.
 6. Domestic hot water priority: Boiler shall make the domestic hot water call for heat a priority over any space heating call and adjust the boiler setpoint to the domestic hot water boiler setpoint.
 7. Domestic hot water modulation limiting: Boiler may be programmed to limit the maximum domestic hot water firing rate to match the input rating of the indirect tank coil.
 8. Domestic hot water night setback: Boiler may be programmed to reduce the domestic hot water tank set point during a certain time of the day.
 9. PC port connection: Boiler shall have a PC port allowing the connection of PC boiler software.
 10. Time clock: Boiler shall have an internal time clock with the ability to time and date stamp lock-out codes and maintain records of runtime.
 11. Maintenance reminder: Boiler shall have the ability to display a yellow colored, customizable maintenance notification screen. All notifications are adjustable by the installer based upon months of installation, hours of operation, and number of boiler cycles.
 12. English Error codes: Boiler shall have a user interface that displays a red error screen with fault codes that are displayed in English and include a date and time stamp for ease of servicing.
 13. Anti-cycling control: Boiler shall have the ability to set a time delay after a heating demand is satisfied allowing the boiler to block a new call for heat. The boiler will display an anti-cycling blocking on the screen until the time has elapsed or the water temperature drops below the anti-cycling differential parameter. The anti-cycling control parameter is adjustable by the installer.
 14. Space Heating Night setback: Boiler may be programmed to reduce the space heating temperature set point during a certain time of the day.
 15. Freeze protection: Boiler shall turn on the boiler and system pumps when the boiler water temperature falls below 45 degrees. When the boiler water temperature falls below 37 degrees the boiler will automatically turn on. Boiler and pumps will turn off when the boiler water temperature rises above 43 degrees.
 16. Isolation valve control: Boiler shall have the ability to control a 2-way motorized control valve. Boiler shall also be able to force a fixed number of valves to always be energized regardless of the number of boilers that are firing.
 17. BMS integration with 0-10V DC input: The Control shall allow an option to Enable and control set point temperature or control firing rate by sending the boiler a 0-10V input signal.
 18. Data logging: Boiler shall have non-volatile data logging memory including last 10 lockouts, space heat run hours, domestic hot water run hours and ignition attempts. All data should be visible on the boiler screen.
- F. The boiler shall have a built in Cascade controller to sequence and rotate lead boiler to ensure equal runtime while maintaining modulation of up to 8 boilers of different btu inputs

without utilization of an external controller. The factory installed, internal cascade controller shall include:

1. Lead lag: The Control module shall allow only one boiler to fire at the beginning of a call for heat. Once the lead boiler is in full fire and the control calculates that additional heat is required it will call on an additional boiler as needed.
 2. Efficiency optimization: The Control module shall allow multiple boilers to simultaneously fire at minimum firing rate in lieu of Lead/Lag.
 3. Front end loading: The Control module shall allow the cascading and functional control of several non condensing Lochinvar products alongside the Knight FTXL.
 4. Rotation of lead boiler: The Control module shall change the lead boiler every hour for the first 24 hours after initializing the Cascade. Following that, the leader will be changed once every 24 hours.
- G. Boiler operating controls shall include the following devices and features:
1. Set-Point Adjust: Set points shall be fully adjustable by the installer.
 2. Sequence of Operation: Boiler shall come standard with outdoor reset control which will control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 10 deg F outside-air temperature, set supply-water temperature at 180 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 140 deg F.
- H. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation and include:
1. High Temperature Limit: Automatic and manual reset stops burner if operating conditions rise above maximum boiler design temperature. Limit switch to be manually reset on the control interface.
 2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manually reset on the control interface.
 3. High and Low Gas Pressure Switches: Pressure switches shall prevent burner operation on low or high gas pressure. Pressure switches to be manually reset on the control interface.
 4. Blocked Drain Switch: Blocked drain switch shall prevent burner operation when tripped. Switch to be manually reset on the control interface.
 5. Optional Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for any lockout conditions.
- I. Retain paragraph and subparagraphs below if boiler controls interface with building automation system.
- J. Building Automation System Interface:
1. Boiler shall have the ability to receive a 0-10V system from a building management system and control by the following:
 - a. 0-10V DC input to control Modulation or Setpoint
 - b. 0-10V DC output signal to a Variable speed system pump
 - c. 0-10V DC input Enable/Disable signal
 2. Factory installed Modbus gateway interface to enable building automation system to monitor, control, and display boiler status and alarms.
- K. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
1. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.

2.07 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.
- B. Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

2.08 VENTING

- A. Exhaust flue must be Category IV approved PVC, CPVC, polypropylene or stainless steel sealed vent material from one of the approved manufacturers listed in the Installation and Operation manual. Boilers exhaust vent length must be able to extend to 100 equivalent feet.
- B. Intake piping must be of approved material as listed in the Installation and Operations manual. Boilers intake pipe length must be able to extend to 100 equivalent feet.
- C. Boiler venting and intake piping configuration shall be installed per one of the approved venting methods shown in the Installation and Operation manual.
- D. Boilers using common venting must only include like models and the optional common vent damper. Contact the factory for common vent sizing.
- E. Boiler shall come standard with a flue sensor to monitor and display flue gas temperature on factory provided LCD display.
- F. Refer to manufacturer's Installation and Operations manual for detailed venting instructions and approved manufacturers.

2.09 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Provide factory tests to check construction, controls, and operation of unit.
- C. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.
- D. Manufacturer to conduct boiler inspection, in accordance to ASME Boiler and Pressure Vessel Code, prior to shipment. Submit copy of inspection report to Architect.
- E. Non-Complying Work: See Section 014000.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
- B. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in of piping and electrical connections.
- C. Examine mechanical spaces for suitable conditions where boilers will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install gas-fired boilers according to NFPA 54.
- B. Assemble and install boiler trim.
- C. Install electrical devices furnished with boiler but not specified to be factory mounted.

- D. Install control wiring to field-mounted electrical devices.
- E. Install in accordance with manufacturer's instructions.
- F. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.
- G. Install boiler on concrete housekeeping base.
- H. Coordinate factory installed controls with Section 230913.
- I. Coordinate provisions for water treatment in accordance with Section 232500.
- J. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.
- K. Provide piping connection and accessories in accordance with Section 232114.
- L. Provide for connection to electrical service in accordance with Section 260583.
- M. Connect vent combustion generated fumes to breeching, chimney or exhaust stack; see Section 235100.
- N. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front end interface. Refer to Specification Section 230923.

3.03 CONNECTIONS

- A. Install boilers level on concrete bases. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of equipment connection. Provide a reducer if required.
- E. Connect hot-water piping to supply and return boiler tapings with shutoff valve and union or flange at each connection.
- F. Install piping from safety relief valves to nearest floor drain.
- G. Boiler Venting:
 - 1. Install flue venting kit and combustion-air intake.
 - 2. Connect full size to boiler connections. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks."
- H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in Tests and Inspections:
- B. Perform installation and startup checks according to manufacturer's written instructions. Complete startup form included with Boiler and return to Manufacturer as described in the instructions.

- C. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
- D. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
- E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 1. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
 - 2. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- F. 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 two visits to Project during other than normal occupancy hours for this purpose.

3.05 DEMONSTRATION

- A. Engage a factory representative or a factory-authorized service representative for boiler startup. Start-up sheet shall be completed and a copy shall be sent to the Engineer and the Manufacturer. A combustion analysis shall be completed and the gas valve adjusted per the Installation and Operations manual and note in start-up report.
- B. Factory representative or a factory-authorized representative shall provide Owners training to instruct maintenance personnel to adjust, operate, and maintain boilers. Refer to Division 01 Section "Demonstration and Training."

3.06 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals for closeout submittals.
- B. See Section 017900 - Demonstration and Training for additional requirements.
- C. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- D. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's training personnel.
 - 4. Location: At project site.

END OF SECTION 235216

**SECTION 238200
CONVECTION HEATING UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electric unit heaters.

1.02 RELATED REQUIREMENTS

- A. Section 230513 - Common Motor Requirements for HVAC Equipment.
- B. Section 230923 - Direct Digital Control System for HVAC
- C. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.
Installation of room thermostats. Electrical supply to units.

1.03 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
 - 2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
 - 3. Submit the following for electric unit heaters indicating:
 - a. Overall dimensions including installation, operation, and service clearances.
 - b. Lift points, recommendations, and center of gravity.
 - c. Unit shipping, installation, and operating weights including dimensions.
 - d. Safety and start-up instructions.
 - e. Capacity and electrical requirements.
 - 4. Indicate mechanical and electrical service locations and requirements.
- D. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide 5 year manufacturer's warranty.

PART 2 PRODUCTS

2.01 ELECTRIC UNIT HEATERS

- A. Manufacturers:
 - 1. INDEECO
 - 2. Modine
 - 3. Trane
 - 4. Markel
 - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
- C. Heating Element Assembly:
 - 1. Thermal safety cut-out within electric terminal box with automatically reset switch located near electric terminal box.
 - 2. Horizontal Projection Units:
 - a. Steel fins copper brazed to steel sheath and epoxy sealed for moisture resistance.
 - b. Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.
 - c. High-mass, all steel tubular type, copper brazed, centrally located and installed in fixed element banks.
 - 3. Vertical Projection Units:
 - a. Finned tubular.
 - b. Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.
 - c. High-mass, all steel tubular type, copper brazed, centrally located and installed in fixed element banks.
- D. Housing:
 - 1. Suitable for ceiling or high altitude mount using provided hardware appendages.
 - 2. Horizontal Projection Units:
 - a. Construction materials to consist of heavy gauge steel with galvanized, polyester powder coat, or high gloss baked enamel finish.
 - b. Provide with threaded holes for threaded rod suspension.
 - c. Provisions for access to internal components for maintenance, adjustments, and repair.
 - 3. Vertical Projection Units:
 - a. Construction materials to consist of heavy gauge steel with polyester powder coat or high gloss baked enamel.
 - b. Provide with mounting support brackets or provisions for mounting from ceiling or structure above.
 - c. Provisions for access to internal components for maintenance, adjustments, and repair.

- E. Air Inlets and Outlets:
 - 1. Inlets: Provide protective grilles with fan blade guard.
 - 2. Outlets: Provide directional louvers.
- F. Fan: Factory balanced, direct drive, axial type with fan guard.
- G. Motor: Totally enclosed, thermally protected, and provided with permanently lubricated bearings.
- H. Controls: Coordinate with Temperature Controls Contractor
 - 1. 24-volt auxiliary relay.
 - 2. Fan override to purge residual heat when de-energized.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.
- C. Do not damage equipment or finishes.
- D. Unit Heaters:
 - 1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
 - 2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- E. Units with Electric Heating Elements:
 - 1. Install as indicated including electrical devices furnished by manufacturer but not factory installed.
 - 2. Install wiring in accordance with the manufacturer's wiring diagram submittal and Section 260583.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Provide manufacturer's field representative to test, inspect, instruct, and observe.

3.04 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.
- B. After construction and painting is completed, clean exposed surfaces of units.
- C. Vacuum clean coils and inside of units.
- D. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals for closeout submittals.
- B. See Section 017900 - Demonstration and Training for additional requirements.

3.06 PROTECTION

- A. Provide finished cabinet units with protective covers during the balance of construction.

END OF SECTION 238200

**DIVISIONS 26 & 28
ELECTRICAL SYSTEM SPECIFICATION INDEX**

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**SECTION 260500
GENERAL ELECTRICAL PROVISIONS**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. A. This Division of Work shall include all labor, materials, tools, equipment and services necessary for and/or reasonably incidental to the furnishing and installation of electrical work as shown on the contract documents and specified herein, for a complete and operable installation.
- B. The documents encompassed by these specifications and the attached drawings outline the work and/or materials required to furnish, install, alter, and/or expand the electrical system to provide a complete, finished and operational project. This shall include all associated cutting, patching, excavation, backfill, compaction, concrete bases, supports, auxiliary steel, inserts, anchors, chases, sleeves, etc., required to accomplish all portions of the this Work, without relying upon other trades, or the work described in other divisions of the specifications, unless it is specifically stated in Division 26 or on the Electrical Drawings, that an item will be provided by another trade. Wherever the word 'provide' is used, it shall be understood to mean: furnish and install complete and ready for proper use.
- C. Work by others:
 - 1. All electric motors for building equipment, appliances, and utility systems, will be furnished under other divisions of these specifications
 - 2. All electric work associated with equipment control and temperature control systems, devices, and panels, including the associated raceways and conductors, shall be provided under Division 23, unless specifically noted otherwise.
 - 3. Field painting of electrical equipment, conduit, boxes, supports, etc., other than touch-up work to repair factory finishes, will be provided by others (as specified elsewhere in these specifications).

1.02 DRAWINGS

- A. The accompanying drawings are complementary to the specifications. Work indicated by either, shall be considered as being required by both. No apparent omission from the Drawings shall relieve the Contractor from providing equipment, materials, or services described by the electrical specifications or drawings.
- B. The Drawings may be superseded by later revised drawings or specification addenda and the Contractor shall conform to all reasonable changes without extra cost to the Owner. All items not specifically mentioned in the specifications or noted on the drawings but which are obviously necessary to make a complete working installation, shall be included.
- C. The electrical drawings are schematic in nature. The exact location of conduits, boxes, devices, fixtures, etc., (not referenced by dimension), shall be determined in the field considering interferences, structural conditions, appearance, and the work of other trades. Minor changes in the location of electrical items, from that shown on the drawings, shall not constitute a reason for additional compensation. This contractor shall field verify dimensions indicated by scaling the plans, since actual distances, locations and elevations will be governed by actual field conditions.

1.03 RELATED DOCUMENTS AND REFERENCES

- A. The Instructions to Bidders, General Conditions, Special Conditions, Addenda, Alternates, these Technical Specifications and the Drawings together with the Contract and Proposal Form comprise the Contract Documents for the Electrical Contract.
- B. Bidder shall refer to applicable portions of Division 1 – General, as many of the general requirements stated therein apply to or will affect the Electrical work and coordination between the trades is required.
- C. The term Associate as used herein refers to the design team on the project including the prime Architectural or Engineering design firm responsible for the drawings.

1.04 REFERENCED CODES AND STANDARDS

- A. Perform all work in accordance with the latest edition of the National Electrical Code as issued by the National Fire Protection Association International, National Electrical Safety Code, Life Safety Code, State of Ohio Building Codes, and any local codes or ordinances.
- B. All work, materials and apparatus shall conform to the rules and regulations of the National Board of Fire Underwriters, to the Codes and Standards of the various National Engineering Societies applicable to the work in question, and to the following:

ACIL	American Council of Independent Laboratories
ANSI	American National Standards Institute
ASTM	American Society for Testing & Materials
AWS	American Welding Society
FM	Factory Mutual
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety & Health Administration
UL	Underwriters Laboratories, Inc.
- C. The above standards are minimum requirements. When plans and/or specifications call for higher standards, the plans and/or specifications shall govern.
- D. All materials shall be installed using tools, methods, means, supports, etc., as may be recommended by the material manufacturer, even if more stringent than the governing codes or regulations specified by the NEC and the State Building Code.

1.05 PERMITS AND FEES

- A. All plan approvals required by any of the foregoing will be secured and paid for by the Contractor and the proper copy distributed to the Associate.
- B. All Electrical Work shall be inspected by the Bureau of Construction Codes, Permit Division, P.O. Box 30255, Lansing, MI 48909 (Phone: 517-241-9313) or the local building inspection department, where certified as the Inspection Authority for this project and site.
- C. Upon completion of the work, this Contractor shall furnish to the Associate certification or evidence of final approval from said Authority before final payment on contract.
- D. All fees for inspection and permits shall be a part of the Contract, the cost of which shall be included in the Contractor's Bid.

1.06 QUALITY ASSURANCE

- A. All material manufacturers shall be firms regularly engaged in the manufacture of products for electrical work of the sizes, types and ratings as specified, and whose products have been in satisfactory use in similar service for not less than three (3) years.
- B. Contractors shall have at least ten (10) years of successful installation experience on electrical projects similar to that required for this work.

1.07 SUBMITTALS

- A. Related requirements:
 - 1. Section 260512 "Submittal Procedures" for information and requirements on approval drawings.
- B. Record Drawings
 - 1. Contractor shall keep in the field, and open to inspection, an accurate and current record of all deviations from Contract Drawings and Specifications. He shall neatly and correctly enter in colored marker any deviations on drawings affected. An extra set of drawings will be furnished for this purpose.
 - 2. On completion of the work, the record drawings shall indicate actual routing of conduit (i.e. above ceiling, in slab), location of outlets, circuit numbering for all lighting, power and receptacle circuits. Underground feeders and duct-banks shall be located by dimension to assist in future excavations. Before final approval, contractor shall certify to the accuracy of each sheet by signature thereon and deliver same to Associate.
 - 3. At completion of the project, the Record Drawings will be delivered to the Owner by the Contractor along with the final Instruction Manuals. Record drawings shall be delivered to the Associate within 30 days of project acceptance.
 - 4. All final operating and instruction manuals, record drawings, etc., shall be completed and turned over to the Associate prior to request for final payment.
- C. Instruction Manual: Bind the written operating instructions, shop drawings, equipment catalog cuts and manufacturer's maintenance instructions into a hard-backed binder, so that they can be accommodated into 8 1/2" X 11" size. Provide written instructions for each system requiring operator intervention under normal and design conditions. Submit one copy to the Associate for review. Upon approval, submit three (3) copies to the Associate for delivery to the Owner. Materials shall be assembled as follows:
 - 1. Title Page--Title of Job, Owner, Address, Date of Submittal, Name of Contractor and Name of Associate.
 - 2. Index of all sections
 - 3. A section listing items requiring periodic service and for proper operation, and either state the service needed or refer to the manufacturer's data in the binder that describes the proper service.
 - 4. A section of all project shop drawings, complete with a section index.
 - 5. A section of all material manufacturer's operating instructions, complete with a section index.
 - 6. A list of all material (other than basic materials) and material suppliers used on the job, Contractor's purchase order numbers, supplier's name and address, for future use by the owner's maintenance personnel.

7. List of a qualified service agency or contractor for each electrical system or major electrical component that may require service.

1.08 VISITING THE SITE

- A. Contractor shall examine the site and compare it with the drawings and specifications, and shall satisfy himself as to all conditions under which the work is to be performed. Failure to do so shall be deemed as acceptance of existing conditions. The contractor shall ascertain and check the location of any existing structures or equipment that may affect this work.
- B. It shall be the responsibility of this Contractor to refer to any discrepancies upon examination of site and drawings to the Associate before bid due date. No allowances shall be made on his behalf for any extra expense to which he may be put due to failure or neglect on his part to make such examination.

1.09 GUARANTEE

- A. This Contractor shall guarantee his workmanship and materials for a period of one year from the date of final acceptance and leave his work in perfect order at completion. Should defects develop within the guarantee period, this Contractor shall, upon notice of same, remedy the defects and have all damages to other work or furnishings caused by the defects or the work of correcting same repaired and/or replaced at his expense, to the condition before such damage. The date of final acceptance is defined as the date of signature of the Associate on the final payment of this Contract, unless otherwise defined in the General or Special Conditions.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Unless specified otherwise, all materials shall be new and of the best quality and, if applicable, materials shall bear certification of quality. If requested, Contractor shall furnish satisfactory evidence as to the kind and quality of materials.
- B. Provide all basic electrical materials including conduit, raceways, fittings, conductors, cabling, trays, boxes, supports, devices, connections, cover plates, grounding, controls, labeling, etc., whether or not specifically shown, specified or noted, as may be required for a complete and operable installation,

2.02 STANDARDS & SUBSTITUTIONS

- A. Those articles, devices, materials, forms of construction, fixtures, etc., named in the specifications to denote the kind and quality required, whether or not the words "or equal" are used, shall be known as "Standards" and all proposals shall be based on same. Where two or more "Standards" are named together, the successful bidder may furnish any one of the "Standards" named, but Contractors shall make their selections known to Associate within 30 days following award of their contract.
- B. Note that "substitutions" are not permitted except under the strict guidelines of the General Conditions. In no case will a "substitution" affect determining of the lowest bid.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All work shall be done by technicians skilled in the particular trade involved and shall be of the best quality, shall be done in a neat, workmanlike manner, up to present standards and practices.

- B. Installation shall be so made that its several component parts will function together as a workable system. It shall be complete with all accessories necessary for its operation and shall be left with all equipment properly adjusted and in working order.
- C. Work shall be executed in conformity with best practice and so as to contribute to efficiency of operation, minimum maintenance, accessibility and sightliness.
- D. All installations shall provide for efficiency of operation, ease of maintenance, efficient utilization of space, and good construction practice, in concert with all other trades and contractors. Special care shall be exercised to insure that proper equipment maintenance and normal component replacements may be accomplished after final project completion without removal of excessive unrelated items of equipment, raceways, boxes, etc.
- E. The Contractor shall have in charge of the work at all times during construction a competent foreman or superintendent, experienced in the work to be installed under this division of the work and with previous experience as a foreman for the successful Contractor. Note that selection of the foreman shall be subject to the approval of the Associate and Owner.
- F. Immediately correct all work that is found unacceptable by the Associate. Work shall be unacceptable where it is not in conformance with the Drawings, Specifications or normal standards of good workmanship.

3.02 COORDINATION

- A. This Contractor shall review the drawings and specifications of others trades involved in the project, and shall examine the work of such, to which his work must connect, attach, align, or otherwise coordinate. This Contractor shall, in no case, connect to, attach to, cover up, or finish work adjacent to defective or improper work, but shall notify the appropriate other contractor and the Associate, upon such circumstance.
- B. The Contractor must be prepared to enter upon his work promptly and shall layout and conduct his work at all times so as not to interfere unnecessarily with the operations of the Owner or other contractors. He shall work in harmony with such other contractors and the Owner to the best interests of the job as a whole. Provide adequate and timely input to the contractor preparing "coordination drawings" where specified elsewhere. All conflicts shall be resolved in the best interest of the Owner and the successful completion of the project.
- C. Contractor shall layout his work and be responsible for correct locations, elevations, and dimensions of all work executed under this contract. He shall exercise proper precautions to verify figures shown on drawings before laying out the work and shall be held responsible for any error resulting from his failure to exercise such precaution.
- D. No pleas as to acts, orders, directions or supervision of the Associate or Owner shall be admitted as justification of any error or departure from the terms of the Contract, unless such order or directions are explicitly given in writing.

3.03 SCHEDULING

- A. Contractor shall take special note of the construction phasing and time constraints in other portions of these specifications. It is necessary that this Contractor cooperate closely with the Associate, Owner and General Contractor as to the areas of work and coordination of the various trades, etc. It shall be the responsibility of this Contractor to carefully plan his delivery and work schedule to coincide with operation and schedule of the other Contractors.
- B. This Contractor shall work closely with the General Contractor and submit a Construction Schedule to coordinate with the General Contractors Schedule prior to actual start of construction and shall outline specifically those items whose delivery or installation may cause schedule difficulties. See Division 1.

- C. Exposed raceways and boxes installed after the room has been painted, shall be painted to match the room finish, at the expense of this contractor.

3.04 CLEANING AND FINISHING

- A. After all tests have been completed and approved by the Associate and Owner, this Contractor shall clean all fixtures and equipment leaving everything in working order at completion of the work.
- B. All tags, stickers, markings, etc., shall be removed from fixtures, conduit and equipment. All operating instructions, connections diagrams, etc., furnished with equipment shall be turned over to the Associate as part of the Operating Instruction Brochure.
- C. Finally, all debris created by execution of electrical work shall be removed by this Contractor.

3.05 FIELD TESTING

- A. Contractor shall conduct such tests and adjustments of equipment as required by Associate or necessary to verify performance requirements. Submit data taken during such tests to Associate. Contractor shall pay all professional engineering fees involved in required testing of equipment. Tests shall include the operation of all lights and equipment, and grounding and insulation resistance measurements on not more than ten (10) representative circuits and any others for which a technical reason exists for such testing.
- B. This Contractor shall provide necessary electrical personnel and testing instruments as required or desired by the Associate to insure proper performance or load balance, etc.
- C. Load Balancing: This Contractor shall furnish personnel and equipment and insure that building power, lighting, motor and appliance loads are balanced between phases of service entrances, distribution feeders and/or transformers to within ten (10) per cent under maximum load conditions. Special care shall be taken during load balance to assure that reverse rotation of motors is not caused.
- D. Phasing/Rotation: All panels, switches, switchgear, motor control, etc., shall be checked and verified in the presence of the Associate for "ABC" - "CLOCKWISE" rotation in accordance with NEMA Standards and Recommendations. This includes all existing panels and switchgear being re-fed. Exercise caution that reconnections of panel feeders, etc., do not cause any motor phase rotation reversal.
- E. At the completion of the project, Contractor shall verify complete Ground/Neutral separation except at the main service bonding jumper and shall clear and correct all other grounded neutrals within his scope of work. (This generally requires a power outage coordinated with the utility company).

3.06 EQUIPMENT AND SYSTEM DEMONSTRATIONS

- A. All special purpose equipment, such as Standby Power Systems, Automatic Transfer Switches, Exterior Lighting Contactors and controls, etc., shall be demonstrated in the presence of the Owner and Associate, including operation of random devices, components and wiring, to verify proper operation of the finished installation.
- B. System demonstrations shall be scheduled ONLY after all devices, components, etc., have been fully tested and system is in final operating condition.

END OF SECTION 260500

**SECTION 260505
RELATED WORK**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide work associated with the electrical installation, which is closely associated therewith, and required for a complete and operational installation. Such work may be non-electrical in nature, but shall be provided by this contractor, in order to assure coordination and installation responsibility by this contractor. Such work shall include cutting and patching, excavation and backfilling, concrete work, and other items as may be described on the plans.
- B. Where final interior or exterior finishes of this related work, is to remain exposed, such finishes shall be provided via workers or subcontractors specifically trained in the work to be performed, all at the expense of this contractor.

1.02 RELATED DOCUMENTS

- A. Refer to section 260500 for general requirements for the electrical work.
- B. Refer to the General Trades Specification Sections for other requirements for cutting and patching.
- C. Refer to the General Trades Specification Sections for requirements for field installed concrete.

PART 2 - PRODUCTS

2.01 NOT APPLICABLE

PART 3 - EXECUTION

3.01 SLEEVES, INSERTS AND OPENINGS

- A. Contractor shall layout and install his work in advance of constructing floors and walls. He shall furnish and install all sleeves and openings through floors and walls required for passage of all conduits, pipes or ducts installed by him. Sleeves shall be heavy gauge galvanized sheet steel, supported and packed to prevent ingress of concrete. All necessary cutting and patching to correct improperly installed material shall be done at this Contractor's expense. No horizontal chases will be allowed. Provide all necessary inserts for support of electrical equipment.
- B. All conduits, sleeves, outlet boxes, fittings, etc., shall be properly closed with fireproof materials and patched where passing through walls, floors or ceilings in accordance with NEC 300.21 for prevention of fire spread. Sealant material shall be Dow Corning RTV Silicone Foam, UL Listed and tested for fire penetration sealing or equal by Nelson or Burndy.
- C. Where conduits, cable tray, ducts, etc., pass thru walls, floors or ceilings the opening around said penetration shall be sealed against moisture and fire penetration.

3.02 FIRE PROOFING

- A. Pipe or duct penetrations thru all floors, fire walls or rated ceilings shall be sealed by the E.C. to prevent spread of fire and smoke and ingress of moisture.
- B. Areas around conduits or sleeves shall be filled with a dielectric, non-hardening putty as manufactured by 3M Company or expanding caulk materials such as Silicone R.T.V. Foam or equal with appropriate fire ratings.

- C. Large openings in floors or masonry walls may be sealed using light weight, low density expanding mortar as made by 3M Company, or equal with appropriate fire ratings.
- D. Large openings around bus ducts or cable trays where passing thru fire rated wall shall be sealed using fire seal bags stuffed into the opening. Bags shall be coated intumescent materials, flexible and conformable and shall be easily removable and re-useable for retrofit applications. Bag seals shall be as manufactured by 3M Company or Spec Seal. or equal.
- E. All fire and smoke penetration seals shall be properly closed using U.L. Listed Products to match the penetration firestop system designation and all fire and smoke stop materials shall be free of asbestos, dangerous solvents, non-halogenated and shall not produce toxic fumes or smoke during exposure to fire. Fire stop shall be designed and installed to provide a minimum 2 hour rating. All fire stop materials shall be installed in strict accordance with the manufacturer's installation instructions.

3.03 CUTTING AND PATCHING

- A. Contractor shall work in advance of work of others wherever possible, eliminating all cutting and patching. Where such procedure is impossible, cutting and patching shall be done in a neat manner by various mechanics skilled in various trades involved, to the satisfaction of the Associate. No excessive cutting will be permitted, and no structural members shall be cut without consent of the Associate.
- B. Contractor shall do his own cutting and patching as required to properly complete his own work. All floors, walls, ceilings, etc., shall be left in an acceptable condition. Final finishes will be by General Contractor if final finishes have not already been applied. In case final finishes have already been applied before cutting and patching by this contractor, then final finishes shall be replaced or repaired by the General Contractor but at this contractor's expense.
- C. Holes of excessive size caused by this Contractor will be repaired at this Contractor's expense, as directed by the Associate and in accordance with other applicable portions of this specification.
- D. Where underfloor raceway is indicated in existing areas, this contractor shall cut existing concrete floor to proper depth to install the new metal raceway and shall patch the concrete at the new raceway. Final floor finish to be by General Contractor.
- E. Penetration of metal roof deck is not permitted for hangers, supports, clamps, fasteners, etc.

3.04 MOUNTING PADS

- A. All ground mounted electrical equipment shall be mounted on 4" high poured concrete pads.
- B. Pads shall be complete with chamfered or rounded corners and shall provide a smooth level surface for the equipment.
- C. All concrete pads shall be "sealed" before equipment is set in place.

END OF SECTION 260505

**SECTION 260506
ELECTRICAL SITE WORK**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install the exterior underground conduit, pull boxes, handholes, etc., as shown on the plans to accommodate the utility company services and exterior components as indicated.

1.02 RELATED DOCUMENTS

- A. Comply with the applicable General Trades Specification Sections for specifications pertaining to excavation, backfill and other site related work.
- B. See section 260533 for raceway requirements

1.03 COORDINATION

- A. Underground Utilities Notification:
 - 1. Each Contractor(s) to whom a contract for a public improvement is awarded shall, at least two working days, excluding Saturdays, Sundays and legal holidays, prior to commencing work cause notice to be given to the utilities, in writing, by telephone or in person.
 - 2. Each Contractor shall alert immediately the occupants of nearby premises as to any emergency that he may create or discover on or near such premises of the underground facility any break or leak on its lines or any dent, gouge, groove or other damage.
- B. Prior to digging or drilling, Contractor shall contact the Michigan Utility Notification Center (Miss Dig System (811) or 1-800-482-7171) to have known public utilities located and marked to avoid damage to existing underground utilities.

PART 2 - PRODUCTS

2.01 UNDERGROUND WARNING

- A. Underground raceway warning tape shall be bright yellow or orange, 6" wide, with imprinted lettering "Caution--Buried Electric Line Below". Tape shall be laid continuously through the length of the trench. Warning tape shall be Allen "AMT" or equal.

2.02 HANDHOLES AND JUNCTION BOXES

- A. Handholes shall be of non-metallic construction, mounted flush with grade, complete with heavy duty, gasketed covers, stainless steel bolts and descriptive wording molded into the cover. Small handholes for individual lighting circuits shall be nominal 12 inches by 12 inches by 12 inches with closed bottom. Larger handholes for feeders or conduits two inch diameter and larger, shall be comprised of multiple stacking type boxes. Larger handholes shall be nominal 36 inches by 36 inches by 36 inches deep with open bottom for natural drainage.
- B. Handholes shall be Quazite "PC" Series, Synertech "S" Series or equal, sized as indicated on the plans, described above or as required by the NEC per Article 314.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All new underground raceways outside the foundation walls, including telephone, electrical, lighting circuits, etc., shall be protected via plastic warning tape located 12" below grade and directly above the buried utility line.

- B. Provide new handholes where indicated or required to make splices in wiring. Handholes shall be set flush with grade, atop a six inch thick compacted, crushed stone base extending three inches beyond the handhole length and width.

3.02 EXCAVATION

- A. Trenches shall be opened in straight lines and bottomed out at least four inches (4") below conduits or ducts. Minimum depth of thirty (30) inches shall be maintained between top of conduit, duct or concrete envelope, and finished grade.
- B. Contractor shall cut any interfering trees, remove all stumps, rocks, etc., in the line of excavation. Any shrubbery in line of excavation shall be removed with a ball of dirt and replaced at completion of excavation. Approval of the Associate shall be obtained before any tree is removed.
- C. Where excavation crosses existing lawns, Contractor shall remove sod, properly store and replace sod at completion of excavation. Care shall be exercised during the work to see that no unnecessary damage is done to lawns in the storing of dirt or other construction material. Should unnecessary damage occur, in the opinion of the Associate, the Contractor shall be required to repair lawns at his own expense.
- D. Where existing sidewalks, drives, and roadways must be cut, they shall be cut in straight lines, shall present a neat appearance when re-laid and shall match existing work.

3.03 BACKFILL

- A. Trenches shall be backfilled to a point six inches below grade. Fill material shall be clean earth free of rocks, sticks, etc., bank run gravel or other approved granular material.
- B. Fill shall be placed in six inch layers and compacted to ninety percent (90%) maximum density. Final six inches of fill in lawn or planting areas, shall be top soil free of vegetation, rocks, sticks or other unsuitable material. Top soil shall be compacted with a suitable roller or power tamper. Top soil below sod shall be thoroughly worked to a depth of six inches mixed with commercial fertilizer. Sod shall be laid evenly, tamped and watered thoroughly.
- C. Backfill under roadways, drives and parking areas shall be bank run gravel or approved granular material. Backfill under building walls and/or footers shall be concrete of the same strength as walls or footers.

3.04 EXTERIOR DUCTBANKS

- A. Selected underground raceways in larger sizes may be fibre or plastic duct (PVC) encased in a steel reinforced concrete envelope. Install multiple underground conduits in common trenches, with proper spacers, and other approved fittings including long radius bends, couplings, end bells, fibre to steel adapters, etc. Exercise special care to insure that joints or couplings in underground ducts are sealed to exclude water.
- B. Concrete envelopes shall encase raceways with not less than three inches (3") of concrete, top, bottom and sides, and shall include a No. 4 continuous reinforcing bar at each corner. Underground concrete duct banks shall be dyed "RED" via sprinkling or mixing as a warning for future excavations.
- C. Where raceways pass through concrete walls below grade, set galvanized steel conduit or sleeves, one and one half inch (1 1/2") larger than OD of conduit. Caulk both sides with oakum and wool, or otherwise adequately waterproof opening around conduit.
- D. Underground raceways serving only exterior lighting units may be direct burial rated non-metallic raceways without concrete encasement.

END OF SECTION 260506

**SECTION 260512
SUBMITTAL PROCEDURES**

PART 1 GENERAL

1.01 SUMMARY

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

1.02 DEFINITIONS

- A. Action Submittals: Written and graphic information that require Architect/Engineer's responsive action.
- B. Informational Submittals: Written and graphic information that do not require Architect/Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.03 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/Engineer and additional time for handling and reviewing submittals required by those corrections.

1.04 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect/Engineer's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will be provided by Architect/Engineer for Contractor's use in preparing submittals. Do not base Submittals on reproductions of the Contract Documents or standard printed data.
 - 1. Architect/Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect/Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. 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. Architect/Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect/Engineer'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 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 14 days for review of each resubmittal.

- D. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Stamp shall include project name, location, specification section, 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.
- 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/Engineer.
 - 3. Include the following information for processing and recording action taken:
 - a. Project name and Date.
 - b. Name of Architect/Engineer.
 - c. Name of Contractor.
 - d. Name of subcontractor.
 - e. Name of supplier.
 - f. Name of manufacturer.
 - g. Number and title of appropriate Specification Section.
 - h. Drawing number and detail references, as appropriate.
 - i. Location(s) where product is to be installed, as appropriate.
 - j. Other necessary identification.
 - 4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect/Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 - 5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect/Engineer will return, without review, submittals received from sources other than Contractor.
- 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.
 - 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect/Engineer.
 - 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect/Engineer, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect/Engineer.
 - 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. Other necessary identification.
 - p. Remarks.
- G. Options: Identify options requiring selection by Architect/Engineer.
- 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 authorization notation from Architect/Engineer's action stamp.
 - 4. Resubmittal Limitation Requirements: The Architect/Engineer will provide time to review the original submittal and ONE resubmittal. If resubmittals are required pursuant to the first resubmittal, the Architect/Engineer's time for these services will be paid by the Contractor. The charges for this time will be back-charged from the Contractor as a change-order through this project's contract. These charges will be based upon the Architect/Engineering standard hourly rates (i.e. Engineer @ \$125.00/hr, etc.).
- 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 authorization notation from Architect/Engineer's action stamp.

PART 2 PRODUCTS

2.01 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements:
- 1. Issue electronic submittals as PDF electronic files directly to Architect/Engineer's e-mail address.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment. Multiple submittals for a single type of equipment are not acceptable. Submittal for a single type of equipment shall be based on one manufacturer throughout project. Multiple components intended to function together, shall be coordinated and submitted together.
- 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. Clearly mark, highlight, or encircle each copy of each submittal to indicate which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts and Manufacturer's product specifications.
 - b. Standard color charts.

- c. Statement of compliance with specified referenced standards.
 - d. Testing by recognized testing agency.
 - e. Application of testing agency labels and seals.
 - f. Notation of coordination requirements.
 - g. 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. Physical weight.
 - c. Dimensions.
 - d. Finish.
 - e. Electrical ratings: Voltage and amperage.
 - f. Construction details for installation.
 - g. Operating Characteristics.
 - h. Capacities: KVA, temperature rise, control devices, ballast or driver data.
 - i. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data in the PDF electronic file format.
- 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.
 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.
 - h. Items furnished by others: The Contractor will be provided complete manufacturers detailed shop drawings, wiring and connection diagrams, for all equipment to which his work connects. It shall be this Contractor's responsibility to request such drawings in advance of the time they are needed. Work that must be altered because of the Contractor's failure to request and obtain such shop drawings, shall be corrected without additional cost to the owner.
 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 PDF electronic file format.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Submit product schedule in PDF electronic file format.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. 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.

- G. 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.
- H. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. 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.
- K. 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.
- L. 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.
- M. 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.
- N. 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.
- O. 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.
- P. 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.

PART 3 EXECUTION

3.01 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/Engineer.
- B. 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.

3.02 ARCHITECT/ENGINEER'S ACTION

- A. General: Architect/Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

- B. Action and Informational Submittals: Architect/Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect/Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - 1. Architect/Engineer's Review Status:
 - a. No Exceptions Taken
 - b. Exceptions Taken As Noted
 - c. Resubmit
 - d. Rejected
 - 2. Action Required of Contractor:
 - a. Process
 - b. Resubmit
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 260512

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B496 - Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors; 2016 (Reaffirmed 2021).
- D. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2021).
- E. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation; 2018 (Reapproved 2023).
- F. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 4 - Armored Cable; Current Edition, Including All Revisions.
- I. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- J. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- K. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- L. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
- M. UL 719 - Nonmetallic-Sheathed Cables; Current Edition, Including All Revisions.
- N. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.
- O. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members; Current Edition, Including All Revisions.
- P. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 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. Control-Circuit Conductors.
 - 7. Connectors, splices, and terminations rated 600 V and less.

1.04 ACTION SUBMITTALS

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

- B. Product Schedule: Indicate type, use, location, and termination locations.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and manufacturer's authorized service representative.
B. Field quality-control reports.

1.06 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

2.01 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. **Okonite Company (The).**
 2. **Southwire Company.**
 3. **Superior Essex Inc.**
- 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 B3 for bare annealed copper and with ASTM B8 or ASTM B496 for stranded conductors.
- E. Conductor Insulation:
1. Type NM: Comply with UL 83 and UL 719.
 2. Type RHH and Type RHW-2: Comply with UL 44.
 3. Type USE-2 and 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 and Type THWN-2: Comply with UL 83.
 6. Type THW and 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.

2.02 ALUMINUM BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn aluminum 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. **Okonite Company (The).**
 2. **Southwire Company.**
 3. **Superior Essex Inc.**
- 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: Aluminum, complying with ASTM B800 and ASTM B801.
- E. Conductor Insulation:
 1. Type NM: Comply with UL 83 and UL 719.
 2. Type RHH and Type RHW-2: Comply with UL 44.
 3. Type USE-2 and 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 and Type THWN-2: Comply with UL 83.
 6. Type THW and Type THW-2: Comply with NEMA WC 70/ICEA S-95-658 and UL 83.
 7. Type XHHW-2: Comply with UL 44.

2.03 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; Atkore International.**
 2. **Southwire Company, LLC.**
 3. **WESCO.**
 4. **Encore Wire Corporation**
 5. **Alpha Wire; brand of Belden Inc.**
 6. **Belden Inc.**
- 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."
 5. Where required, provide health care rated cable with redundant ground conductors in patient care areas as per NEC 517.13.
- D. Circuits:
 1. Single circuit and multi-circuit with color-coded conductors.
 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 2. Type XHHW-2: Comply with UL 44.

- H. Armor: Steel or Aluminum, interlocked.
- I. Jacket: PVC applied over armor.

2.04 ARMORED CABLE, TYPE AC

- A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in an overall metallic sheath.
- B. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **AFC Cable Systems; Atkore International.**
 - 2. **Southwire Company, LLC.**
 - 3. **WESCO.**
 - 4. **Encore Wire Corporation**
 - 5. **Alpha Wire; brand of Belden Inc.**
 - 6. **Belden Inc.**
- 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. Comply with UL 4.
 - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
 - 5. Where required, provide health care rated cable with redundant ground conductors in patient care areas as per NEC 517.13.
- D. Circuits:
 - 1. Single circuit and multi-circuit with color-coded conductors.
 - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation: Type THHN/THWN-2. Comply with UL 83.
- H. Armor: Steel or Aluminum, interlocked.

2.05 FIRE-ALARM WIRE AND CABLE

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following or per Fire Alarm manufacturer recommendations:**
 - 1. **Allied Wire & Cable Inc.**
 - 2. **PYROTENAX; brand of nVent Electrical plc.**
 - 3. **Prysmian Cables and Systems; Prysmian Group North America.**
 - 4. **Radix Wire.**
 - 5. **Superior Essex Inc.; subsidiary of LS Corp.**
 - 6. **West Penn Wire; brand of Belden, Inc.**
- 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 for analog or addressable loops; individual conductors or twisted pair not less than No. 14 for signal circuits. Other conductors size as recommended by system manufacturer.
 - 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.

2.06 CONTROL-CIRCUIT CONDUCTORS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **Encore Wire Corporation**
 - 2. **General Cable; Prysmian Group North America**
 - 3. **Southwire Company, LLC**
- B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway, Type XHHW-2, complying with UL 44 in raceway, Type MC, complying with UL 1569.
- C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway, Type XHHW-2, complying with UL 44 in raceway, power-limited cable, concealed in building finishes.
- D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway, Type XHHW-2, complying with UL 44 in raceway, power-limited cable, concealed in building finishes.
- E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.
 - 1. Smoke control signaling and control circuits.

2.07 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 Incorporated, Power Systems.**
 - 3. **ABB, Electrification Products Division.**
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One or Two hole with standard barrels.
 - 3. Termination: Compression or Crimp.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. All line voltage circuits shall be stranded, copper, 600 Volt insulated: 167 degrees Fahrenheit THHN/THWN for circuits #14 AWG thru #2 AWG; 194 degrees Fahrenheit XHHW-2 for circuits #1 AWG and larger). Conductors #3/0 AWG and larger may be stranded electrical grade standard or compact stranded aluminum conductors with 90 degrees C rated XHHW-2 insulation, properly upsized for the ampacity equivalent to the copper conductors shown; conduit shall also be upsized for aluminum conductors. Branch circuit wiring shall be #12 AWG minimum.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway or Type USE, single conductor in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

3.03 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."

3.04 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.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

3.05 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.

3.06 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."

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to General Trades Specification Sections.

3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. 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, feeder, splices and underground branch circuit and critical equipment conductors.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each below grade splice and splices 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.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- D. Cables will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports to record the following:
1. The test report shall include the following:
 - a. Summary of project.
 - b. Description of equipment tested.
 - c. Description of tests;
 - d. Test data.
 - e. Analysis and recommendations.
 2. Test and inspection data records shall include the following minimum requirements:
 - a. Identification of the testing organization.
 - b. Equipment identification.
 - c. Humidity, temperature and other conditions that may affect the results of the tests/calibrations.
 - d. Date of inspections, tests, maintenance and/or calibrations.
 - e. Identification of the testing technician.
 - f. Indication of inspections, tests, maintenance and/or calibrations to be performed and recorded.
 - g. Indication of expected results when calibrations are to be performed.
 - h. Indication of "as-found" and "as-left" results, as applicable.
 - i. Sufficient spaces to allow all results and comments to be indicated.
 3. The testing organization shall furnish a copy or copies of the complete report as specified in the maintenance testing contract.

END OF SECTION 260519

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2025.
- E. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 70B - Recommended Practice for Electrical Equipment Maintenance; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2026.
- I. UL 96 - Lightning Protection Components; Current Edition, Including All Revisions.
- J. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.
- K. UL 891 - Switchboards; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.

1.04 ACTION SUBMITTALS

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

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in General Trades Specification Sections include the following:
 - a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article:
 - 1) Ground rods.
 - b. Instructions for periodic testing and inspection of grounding features at ground rods and grounding connections based on NETA MTS or NFPA 70B.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.02 MANUFACTURERS

- A. **Manufacturers: Subject to compliance with requirements, provide products by the following:**
 1. **ABB, Electrification Products Division.**
 2. **B-Line; a division of Eaton, Electrical Sector.**
 3. **Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.**
 4. **Hoffman; brand of nVent Electrical plc.**
 5. **allIG Fabrication (formerly ALT).**

2.03 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B3.
 2. Stranded Conductors: ASTM B8.
 3. Tinned Conductors: ASTM B33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.04 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression or exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt or socket set screw.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- L. Straps: Solid copper, cast-bronze clamp or copper lugs. Rated for 600 A.
- M. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- N. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated or stainless-steel bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector or copper ground connector rated for direct burial.

2.05 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Conductors: Green-colored insulation.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3.02 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Pad-Mounted Transformers and Switches: Install grounding per utility company's standards.

3.04 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.

3.05 FENCE GROUNDING

- A. Fence Grounding: Install at maximum intervals of 100 feet except as follows:
 - 1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 25 feet.
 - a. Gates and Other Fence Openings: Ground fence on each side of opening.
 - 1) Bond metal gates to gate posts.
 - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.
- C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

3.06 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.

- a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 260526

**SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- D. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- F. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- G. MFMA-4 - Metal Framing Standards Publication; 2004.
- H. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- J. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- K. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; 2004.
- L. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2025.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2024, with Errata (2025).

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Aluminum slotted support systems.
 - 3. Nonmetallic slotted support systems.
 - 4. Conduit and cable support devices.
 - 5. Support for conductors in vertical conduit.
 - 6. Structural steel for fabricated supports and restraints.
 - 7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 8. Fabricated metal equipment support assemblies.

1.04 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.
 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.

1.05 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. Piping, fittings, and supports.
- B. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M and AWS D1.2/D1.2M.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
 2. Self-extinguishing according to ASTM D635.

2.02 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. **Allied Tube & Conduit; Atkore International.**
 - b. **B-Line; a division of Eaton, Electrical Sector.**
 - c. **CADDY; brand of nVent Electrical plc.**

- d. **Flex-Strut Inc.**
- e. **ABB, Electrification Products Division.**
- 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
- 3. Material for Channel, Fittings, and Accessories:
 - a. Interior Locations: Painted or plain steel.
 - b. Exterior Locations: Galvanized steel, Stainless steel, Type 304 or Stainless steel, Type 316.
- 4. Channel Width: Selected for applicable load criteria.
- 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
- 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
- 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum 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. **ABB, Electrification Products Division.**
 - b. **Eaton**
 - c. **Unistrut; Atkore International.**
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Channel Material: 6063-T5 aluminum alloy.
 - 4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 - 5. Channel Width: Selected for applicable load criteria.
 - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin 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. **Allied Tube & Conduit; Atkore International.**
 - b. **B-line; Eaton, Electrical Sector.**
 - c. **Fabco Plastics Wholesale Limited.**
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Channel Width: Selected for applicable load criteria.
 - 4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.

5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
 6. Rated Strength: Selected to suit applicable load criteria.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. 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.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- G. 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) **MKT Fastening, LLC.**
 - 3) **Simpson Strong-Tie Co., Inc.**
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) **B-line; Eaton, Electrical Sector.**
 - 2) **Hilti, Inc.**
 - 3) **MKT Fastening, LLC.**
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
 6. Toggle Bolts: All Stainless-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 EXECUTION

3.01 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 102.
 - 4. NECA 105.
 - 5. NECA 111.
- 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 scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in 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 or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with either two-bolt conduit clamps, single-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.
- 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.

3.02 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.
- 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 Light Steel: Sheet metal screws.
 7. 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.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 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 General Trades Specification Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

**SECTION 260533
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2025.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit - Aluminum (ERMC-A); 2025.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2025.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- G. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; 2004.
- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- I. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.
- N. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- O. UL 5 - Surface Metal Raceways and Fittings; Current Edition, Including All Revisions.
- P. UL 5A - Nonmetallic Surface Raceways and Fittings; Current Edition, Including All Revisions.
- Q. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- R. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.
- S. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- T. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.
- U. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- V. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- W. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- X. UL 651A - High Density Polyethylene (HDPE) Conduit; Current Edition, Including All Revisions.
- Y. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- Z. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings; Current Edition, Including All Revisions.
- AA. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

- BB. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
- CC. UL 1653 - Electrical Nonmetallic Tubing; Current Edition, Including All Revisions.
- DD. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.
- EE. UL 1773 - Termination Boxes; Current Edition, Including All Revisions.
- FF. UL 2420 - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; Current Edition, Including All Revisions.
- GG. UL 2515 - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; Current Edition, Including All Revisions.
- HH. UL 2515A - Standard for Supplemental Requirements for Extra Heavy Wall Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Boxes, enclosures, and cabinets.
 - 6. Handholes and boxes for exterior underground cabling.

1.04 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.05 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.06 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. Source quality-control reports.

PART 2 PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. GRC: Comply with ANSI C80.1 and UL 6.
 3. ARC: Comply with ANSI C80.5 and UL 6A.
 4. IMC: Comply with ANSI C80.6 and UL 1242.
 5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit or IMC.
 - 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 or aluminum.
 8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
1. Comply with NEMA FB 1 and UL 514B.
 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. Fittings, General: Listed and labeled for type of conduit, location, and use.
 4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 5. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
 6. 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.
 7. 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.
- D. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
- a. **Allied Tube & Conduit; Atkore International.**
 - b. **Crouse-Hinds; brand of Eaton, Electrical Sector.**
 - c. **Topaz Lighting & Electric.**
 - d. **Wheatland Tube; Zekelman Industries.**
 - e. **ABB, Electrification Business.**
 - f. **Southwire Company, LLC.**

2.02 NONMETALLIC CONDUITS AND FITTINGS

- A. Nonmetallic Conduit:
1. 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.
 2. Fiberglass:
 - a. Comply with NEMA TC 14.
 - b. Comply with UL 2515 for aboveground raceways.
 - c. Comply with UL 2420 for belowground raceways.

3. ENT: Comply with NEMA TC 13 and UL 1653.
 4. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
 5. LFNC: Comply with UL 1660.
 6. Rigid HDPE: Comply with UL 651A.
 7. Continuous HDPE: Comply with UL 651A.
 8. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.
 9. RTRC: Comply with UL 2515A and NEMA TC 14.
- B. Nonmetallic Fittings:
1. Fittings, General: Listed and labeled for type of conduit, location, and use.
 2. 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.
 3. Solvents and Adhesives: As recommended by conduit manufacturer.
- C. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
- a. **Allied Tube & Conduit; Atkore International.**
 - b. **Crouse-Hinds; brand of Eaton, Electrical Sector.**
 - c. **Topaz Lighting & Electric.**
 - d. **Wheatland Tube; Zekelman Industries.**
 - e. **ABB, Electrification Business.**
 - f. **Southwire Company, LLC.**

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R 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.
- B. 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.
- C. Wireway Covers: Hinged type, Screw-cover type or Flanged-and-gasketed type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.
- E. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
- a. **Allied Tube & Conduit; Atkore International.**
 - b. **Crouse-Hinds; brand of Eaton, Electrical Sector.**
 - c. **Topaz Lighting & Electric.**
 - d. **Wheatland Tube; Zekelman Industries.**
 - e. **ABB, Electrification Business.**
 - f. **Southwire Company, LLC.**

2.04 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 Prime coated, ready for field painting (verify with architect prior to ordering materials).
- 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.
- D. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.**
 - b. **Wiremold; Legrand North America, LLC.**

2.05 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- C. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- E. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R 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.
- F. Cabinets:
 - 1. NEMA 250, Type 1 or Type 3R 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.
- G. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **ABB, Electrification Business.**
 - b. **Appleton; Emerson Electric Co., Automation Solutions.**
 - c. **Arlington Industries, Inc.**
 - d. **Crouse-Hinds; brand of Eaton, Electrical Sector.**

- e. **Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.**
- f. **Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.**

2.06 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. Standard: Comply with SCTE 77.
 - 2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC" OR "LIGHTING" or as indicated for each service.
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes 12 Inches Wide by 12 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
 - 8. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - 9. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units SCTE 77, Tier 8 structural load rating.
 - 10. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
- C. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **Armorcast Products Company.**
 - b. **Carson Industries LLC.**
 - c. **CDR Systems Corporation.**
 - d. **New Basis.**
 - e. **Quazite.**
 - f. **Synertech.**

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC or IMC.

2. Concealed Conduit, Aboveground: GRC or IMC.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried and GRC.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or LFNC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Elbow: Use GRC for stub-ups from underground runs and for all underground elbows on runs exceeding two-hundred feet.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed 10 feet above finished floor, Not Subject to Physical Damage: EMT.
 2. Exposed 10 feet above finished floor, Not Subject to Severe Physical Damage: EMT.
 3. Exposed 10 feet below finished floor and Subject to Severe Physical Damage: GRC.
Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 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. Elbow: Use GRC for stub-ups from underground runs and for all underground elbows on runs exceeding two-hundred feet and for all panel feeders.
 8. 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: 1/2-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 or compression, steel or cast-metal 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. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 degrees Fahrenheit.

3.02 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.
- 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. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- M. 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.
- N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- 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.
- 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.
 - 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. 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 top of box unless otherwise indicated.
- AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.03 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 General Trades Specification Sections for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified in General Trades Specification Sections.
 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 General Trades Specification Sections.
 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 5. 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.
 6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
 7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.04 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 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.
- E. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- F. If conduits do not enter enclosure through open bottom, 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.

3.05 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."

3.06 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in General Trades Specification Sections.

3.07 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

1.01 REFERENCE STANDARDS

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- B. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- C. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Round sleeves.
 - 2. Rectangular sleeves.
 - 3. Sleeve seal systems.
 - 4. Grout.
 - 5. Pourable sealants.
 - 6. Foam sealants.
- B. Related Requirements:
 - 1. General Trades Specification Sections for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.04 ACTION SUBMITTALS

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

PART 2 PRODUCTS

2.01 ROUND SLEEVES

- A. Wall Sleeves, Steel:
 - 1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.
- B. Wall Sleeves, Cast Iron:
 - 1. Description: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.
- C. Pipe Sleeves, PVC:
 - 1. Description: ASTM D1785, Schedule 40.
- D. Molded Sleeves, PVC:
 - 1. Description: With nailing flange for attaching to wooden forms.
- E. Molded Sleeves, PE or PP:

1. Description: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sheet Metal Sleeves, Galvanized Steel, Round:
 1. Description: Galvanized-steel sheet; thickness not less than 0.0239-inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.02 RECTANGULAR SLEEVES

- A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:
 1. Description:
 - a. Material: Galvanized sheet steel.
 - b. Minimum Metal Thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness must be 0.052 inch.
 - 2) For sleeve cross-section rectangle perimeter not less than 50 inches or with one or more sides larger than 16 inches, thickness must be 0.138 inch.

2.03 SLEEVE SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
 1. Sealing Elements: EPDM or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel, Fiber-reinforced plastic or Stainless steel.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.04 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.05 POURABLE SEALANTS

- A. Description: Single-component, 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.

2.06 FOAM SEALANTS

- A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 EXECUTION

3.01 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.

- B. Sleeves for Conduits 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 space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in General Trades Specification Sections.
 - 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 raceway or cable, unless sleeve seal system is to be installed.
 - 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.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations:
 - 1. Install steel or cast-iron pipe sleeves with integral waterstops. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
 - 2. Install steel pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.02 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.03 INSTALLATION OF SLEEVE SEAL SYSTEMS

- 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.

END OF SECTION 260544

**SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.
- B. 29 CFR 1910.145 - Accident Prevention Signs and Tags; Current Edition.
- C. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- D. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.
- E. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
- F. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- G. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.
- H. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2018.
- I. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- L. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.
- M. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Labels.
 - 2. Bands and tubes.
 - 3. Tapes and stencils.
 - 4. Tags.
 - 5. Signs.
 - 6. Cable ties.
 - 7. Miscellaneous identification products.

1.04 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 electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with ASME 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. Comply with NFPA 70E requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White
 - 3. Colors for 240-V - 1PH Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Neutral: White
 - 4. Colors for 240-V - 3PH Circuits:
 - a. Phase A: Black.
 - b. Phase B: Orange or tagged.
 - c. Phase C: Red
 - d. Neutral: White
 - 5. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray
 - 6. Color for Equipment Grounds: Green.
 - 7. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

- D. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- F. Equipment Identification Labels:
 - 1. Black letters on a white field.
 - 2. White letters on a red field for all Emergency and Standby power equipment.
 - 3. Include item name, voltage and phase. All panelboard and switchboard labels shall indicate the source of supply per NEC 408.4

2.03 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - 2. Marker for Labels:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 degrees Fahrenheit. Comply with UL 224.

2.05 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white or yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
 - d. Tensile according to ASTM D882: 30 lbf (133.4 N) and 2500 psi.
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.06 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch 0.023 inch thick, color-coded for phase and voltage level, with factory screened or printed permanent designations; punched for use with self-locking cable tie fastener.

2.07 SIGNS

- A. Baked-Enamel Signs:
 - 1. Preprinted aluminum signs, high-intensity reflective, 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.
- B. Metal-Backed Butyrate Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, 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.
- C. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Engraved legend.

2. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.08 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.
 5. Color: Black.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.01 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "POWER."
- I. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- J. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- K. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- L. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. 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.
- M. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- N. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- O. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- Q. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- R. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- S. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway 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.
- 2. Limit use of underground-line warning tape to direct-buried cables.
- 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- T. Metal Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.
- U. Nonmetallic Preprinted Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.
- V. Baked-Enamel Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on minimum 1-1/2-inch- high sign; where two lines of text are required, use signs minimum 2 inches high.
- W. Metal-Backed Butyrate Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.
- X. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.
- Y. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels or vinyl tape applied in bands.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "POWER."

- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use either vinyl wraparound labels, self-adhesive wraparound labels, snap-around labels, snap-around color-coding bands or self-adhesive vinyl tape to identify the phase.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- K. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- N. Operating Instruction Signs: Self-adhesive labels, Baked-enamel warning signs, Metal-backed, butyrate warning signs or Laminated acrylic or melamine plastic signs.
- O. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of engraved laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.

- f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- g. Emergency system boxes and enclosures.
- h. Motor-control centers.
- i. Enclosed switches.
- j. Enclosed circuit breakers.
- k. Enclosed controllers.
- l. Variable-speed controllers.
- m. Motor Starters
- n. Push-button stations.
- o. Power-transfer equipment.
- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Power-generating units.
- s. Monitoring and control equipment.
- t. Fire-alarm control panel and annunciators.

END OF SECTION 260553

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**SECTION 260923
LIGHTING CONTROL DEVICES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Photoelectric switches.
 - 2. Indoor occupancy and vacancy sensors.
 - 3. Switchbox-mounted occupancy sensors.
 - 4. Outdoor motion sensors.
- B. Related Requirements:
 - 1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which equipment will be attached.
 - 3. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Control modules.
- B. Field quality-control reports.

- C. Sample Warranty: For manufacturer's warranties.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.07 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 2. Warranty Period: Two year(s) from date of Substantial Completion.

1.08 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. Color Wall Station: Provide 20 spares as a part of the final bid for the owners attic stock.

PART 2 PRODUCTS

2.01 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
1. **Cooper Lighting Solutions**
 2. **Acuity**
 3. **Leviton**
 4. **Watt Stopper**
 5. **Hubbell**
- B. Description: Solid state, with dry contacts rated for 1000 W incandescent or 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
1. Listed and labeled as defined in NFPA 70, by an agency NRTL, 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: Fifteen-second minimum, to prevent false operation.
 4. Surge Protection: Metal-oxide varistor.
 5. Mounting: Twist lock complies with ANSI C136.10, with base from same source and manufacturer as switch.
 6. Failure Mode: Luminaire stays ON.

2.02 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
1. **Cooper Lighting Solutions**
 2. **Acuity**
 3. **Leviton**
 4. **Watt Stopper**
 5. **Hubbell**
- B. General Requirements for Sensors:
1. Wall or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
 2. Dual technology.
 3. Separate power pack.
 4. Hardwired/Wireless connection to switch; and BAS and lighting control system.
 5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 6. Operation:
 - a. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
 8. Power: Line voltage.
 9. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 10. 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.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 12. Bypass Switch: Override the "on" function in case of sensor failure.
 13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Wall or 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.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor.

2.03 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 1. **Cooper Lighting Solutions**
 2. **Acuity**
 3. **Leviton**
 4. **Watt Stopper**
 5. **Hubbell**
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, with provisions for connection to BAS using hardwired connection or using wireless connection.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 4. Switch Rating: Not less than 800-VA ballast or LED load at 120 V, 1200-VA ballast or LED load at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor:
 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft.
 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
 4. Capable of controlling load in three-way application.
 5. Voltage: Match the circuit voltage.
 6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
 9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 10. Faceplate: Color matched to switch.

2.04 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. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. 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.
- C. 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.

3.03 CONTACTOR INSTALLATION

- A. Comply with NECA 1.
- B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.04 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.05 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 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.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- 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. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Lighting control devices will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.07 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to 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.

3.08 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.09 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

**SECTION 262413
SWITCHBOARDS**

SECTION 262413

SWITCHBOARDS

PART 1 GENERAL

3.01 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- C. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
- D. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less; 2023.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- G. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- H. UL 891 - Switchboards; Current Edition, Including All Revisions.
- I. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- J. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

3.02 RELATED DOCUMENTS

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

3.03 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Surge protection devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Control power.
 - 6. Accessory components and features.
 - 7. Identification.
 - 8. Mimic bus.

3.04 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
 - 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.

2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.
- D. Delegated Design Submittal:
 1. For arc-flash hazard analysis and breaker settings.
 2. For arc-flash labels.

3.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency
- B. Seismic Qualification Data: Certificates, for switchboards, overcurrent protective devices, 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. 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.

3.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in General Trades Specification Sections, include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

- c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

3.07 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. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
 - 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
 - 4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
 - 5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
 - 6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

3.08 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

3.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to temporary electrical service] to prevent condensation.
- C. Handle and prepare switchboards for installation according to NECA 400.

3.10 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- C. Unusual Service Conditions: NEMA PB 2, as follows:
 - 1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet.
- D. 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 Architect, Construction Manager and Owner no fewer than two 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 Architect's, Construction Manager's and Owner's written permission.
 4. Comply with NFPA 70E.

3.11 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

3.12 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: 2 years from date of Substantial Completion.
- B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

4.01 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB, Electrification Products Division.
 2. Eaton.
 3. Square D; Schneider Electric USA.
- B. Source Limitations: Obtain switchboards Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. 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.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.

- G. Comply with UL 891.
- H. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Panel or Fixed, individually mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- I. Front- and Side-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Section Alignment: Front and Rear aligned.
- J. Front- and Rear-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
 - 2. Branch Devices: Panel and fixed, individually
 - 3. Sections front and rear aligned.
- K. Nominal System Voltage: As noted on design documents.
- L. Main-Bus Continuous: As noted on design documents
- M. Indoor Enclosures: Steel, NEMA 250, Type 1.
- N. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- O. Barriers: Between adjacent switchboard sections.
- P. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.
- Q. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
 - 1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
 - 2. Space-Heater Power Source: Transformer, factory installed in switchboard.
- R. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.
- S. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- T. Removable, Hinged Rear Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard.
- U. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- V. Pull Box on Top of Switchboard:
 - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 - 2. Set back from front to clear circuit-breaker removal mechanism.
 - 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 - 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.

5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- W. Buses and Connections: Three phase, four wire unless otherwise indicated.
 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
 2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.
 3. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 4. Copper feeder circuit-breaker line connections.
 5. Tin-plated aluminum feeder circuit-breaker line connections.
 6. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 7. Ground Bus: 1/4-by-2-inch, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
 8. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 9. Disconnect Links:
 - a. Isolate neutral bus from incoming neutral conductors.
 - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
 10. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 11. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- X. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- Y. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.
- Z. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

4.02 SURGE PROTECTION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB, Electrification Products Division.
 2. Eaton.
 3. Square D; Schneider Electric USA.
- B. SPDs: Comply with UL 1449, Type 1.
- C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.

- D. Features and Accessories:
 - 1. Integral disconnect switch.
 - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - 3. Indicator light display for protection status.
 - 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 - 5. Surge counter.
- E. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- F. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 1200 V for 480Y/277 V.
 - 2. Line to Ground: 1200 V for 480Y/277 V.
 - 3. Line to Line: 2000 V for 480Y/277 V.
- G. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V.
 - 2. Line to Ground: 700 V.
 - 3. Line to Line: 1000 V.
- H. SCCR: Equal or exceed 100 kA.
- I. Nominal Rating: 20 kA.

4.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating 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. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long and short time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.

6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. 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 material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - h. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- B. Insulated-Case Circuit Breaker (ICCB): 80 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
 1. Fixed circuit-breaker mounting.
 2. Two-step, stored-energy closing.
 3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Time adjustments for long- and short-time pickup.
 - c. Ground-fault pickup level, time delay, and I^2t response.
 4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 5. Remote trip indication and control.
 6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 7. Control Voltage: 40-V dc.
- C. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Siemens Industry, Inc., Energy Management Division.
 - b. Eaton.
 - c. Square D; Schneider Electric USA.

2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
 3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
 - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
 - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
 4. Auxiliary Switches: Factory installed, SPDT, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
 5. Service-Rated Switches: Labeled for use as service equipment.
 6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
 - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
 - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
 - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
 7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- D. High-Pressure, Butt-Type Contact Switch: Operating mechanism uses butt-type contacts and a spring-charged mechanism to produce and maintain high-pressure contact when switch is closed.
1. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
 2. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
 - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
 - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
 3. Auxiliary Switches: Factory installed, SPDT, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
 4. Service-Rated Switches: Labeled for use as service equipment.
 5. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
 - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
 - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
 - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
 6. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.

- E. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- F. Fuses are specified in Section 262813 "Fuses."

4.04 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, and the following:
 - 1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
 - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
 - d. Megawatts: Plus or minus 1 percent.
 - e. Megavars: Plus or minus 1 percent.
 - f. Power Factor: Plus or minus 1 percent.
 - g. Frequency: Plus or minus 0.1 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
 - j. Contact devices to operate remote impulse-totalizing demand meter.
 - 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
- C. Analog Meters:
 - 1. Meters: 4-inch diameter or 6 inches square, flush or semiflush, with anti-parallax 250-degree scales and external zero adjustment.
- D. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
- E. Instrument Switches: Rotary type with off position.
 - 1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
 - 2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.

- F. Ammeters: 2-1/2-inch minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.

4.05 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control Circuits: 120-V ac, supplied from remote branch circuit.
- C. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- D. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- E. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

4.06 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.
- D. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.
- E. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

4.07 IDENTIFICATION

- A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.
 - 1. Nameplate: At least 0.0625-inch- thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.
- B. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.
- C. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.
- D. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
- E. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 EXECUTION

5.01 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400.
 - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
 - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
 - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
 - 4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

5.02 INSTALLATION

- A. Install switchboards and accessories according to NECA 400.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in General Trades Specification Sections.
 - 1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to switchboards.
 - 6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install filler plates in unused spaces of panel-mounted sections.
- F. Install overcurrent protective devices, surge protection devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Install spare-fuse cabinet.
- H. Comply with NECA 1.

5.03 CONNECTIONS

- A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- B. Support and secure conductors within the switchboard according to NFPA 70.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

5.04 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

5.05 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.
- E. Tests and Inspections:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
 - 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 5. Perform the following infrared scan tests and inspections, and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:

- 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Switchboard will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

5.06 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.

5.07 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

5.08 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262413

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SECTION 262416 PANELBOARDS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2025.
- D. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- E. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- I. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- J. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.04 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.

2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include wiring diagrams for power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards.

1.07 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 General Trades Specification Sections, 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.

1.08 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.
 2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.09 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.11 FIELD CONDITIONS

- A. Environmental Limitations:
 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. 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 Architect, Construction Manager and Owner no fewer than two days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Architect's, Construction Manager's or Owner's written permission.
 - 3. Comply with NFPA 70E.

1.12 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 - 1. Panelboard Warranty Period: 2 years from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
 - 1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush or Surface-mounted, dead-front cabinets.
 - 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.
 - c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Height: 84 inches maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
 - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:
 - a. Panels and Trim: Steel or 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.
- F. Incoming Mains:
 1. Location: Convertible between top and bottom.
 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- G. Phase, Neutral, and Ground Buses:
 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
 6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
 7. Split Bus: Vertical buses divided into individual vertical sections.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 4. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
 6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have

- meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 - 1. Percentage of Future Space Capacity: 10 percent.
 - K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
 - 1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 - 2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 18,000 A rms symmetrical.
 - L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
 - 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 18,000 A rms symmetrical.

2.02 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.03 POWER PANELBOARDS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **Square D; Schneider Electric USA.**
 - 2. **GE/ABB**
 - 3. **Eaton**
 - 4. **Siemens Industry, Inc., Energy Management Division.**
- B. **Square D, Siemens, GE or Cutler Hammer. Panels shall match existing type in facilities, field verify.**
- C. Panelboards: NEMA PB 1, distribution type.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- E. Mains: Circuit breaker, Fused switch or Lugs only.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers or Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- H. Branch Overcurrent Protective Devices: Fused switches.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **Square D; Schneider Electric USA.**
 - 2. **GE/ABB**
 - 3. **Eaton**
 - 4. **Siemens Industry, Inc., Energy Management Division.**
- B. **Square D, Siemens, GE or Cutler Hammer. Panels shall match existing type in facilities, field verify.**
- C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- D. Mains: Circuit breaker or lugs only.
- E. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Devices shall match selected panel manufacturer.
- B. MCCB: Comply with UL 489, with series-connected rating or interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).

6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted or Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - j. Auxiliary Contacts: One, SPDT switch or Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - k. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - l. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - m. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - n. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
 - o. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - p. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
 2. Fused Switch Features and Accessories:
 - a. Standard ampere ratings and number of poles.
 - b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
 - c. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.06 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
 - 2. Directory shall note for all spares and spaces.

2.07 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- 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. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- D. Equipment Mounting:
 - 1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.

- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- J. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- L. Install filler plates in unused spaces.
- M. Place all spare circuit breakers in the off position.
- N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- O. Mount spare fuse cabinet in accessible location.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in 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. Handwritten directories are not acceptable. Install directory inside panelboard door.
- 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 power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
 1. Measure loads during period of normal facility operations.
 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.06 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

**SECTION 262726
WIRING DEVICES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- E. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- H. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- I. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Standard-grade receptacles, 125 V, 20 A.
 - 2. GFCI receptacles, 125 V, 20 A.
 - 3. Cord and plug sets.
 - 4. Toggle switches, 120/277 V, 20 A.
 - 5. Decorator-style devices, 20 A.
 - 6. Wall plates.

1.04 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.05 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.

1.06 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.07 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

2.01 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 use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. 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 requirements in this Section.
- F. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- G. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected on design documents or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Essential Electrical System: Red.
- H. Wall Plate Color: Smooth high impact plastic or stainless steel in finished areas. Galvanized for unfinished areas. For plastic covers, match device color. Refer to drawings for requirements.
- I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell
 - b. Eaton
 - c. Leviton
 - 2. Description: Two pole, three wire, and self-grounding.
 - 3. Configuration: NEMA WD 6, Configuration 5-20R.
 - 4. Standards: Comply with UL 498 and FS W-C-596.
- B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell
 - b. Eaton
 - c. Leviton

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Standards: Comply with UL 498.
 5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.
- C. Tamper-Resistant Duplex Receptacles, 125 V, 20 A :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell
 - b. Eaton
 - c. Leviton
 2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Standards: Comply with UL 498 and FS W-C-596.
 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.03 GFCI RECEPTACLES, 125 V, 20 A

- A. Duplex GFCI Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell
 - b. Eaton
 - c. Leviton
 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
- B. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell
 - b. Eaton
 - c. Leviton
 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 3. Configuration: NEMA WD 6, Configuration 5-15R.
 4. Standards: Comply with UL 498 and UL 943 Class A.
 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.04 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. 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.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.05 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A:
 - 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **Hubbell**
 - b. **Eaton**
 - c. **Leviton**
 - 2. Standards: Comply with UL 20 and FS W-S-896.

2.06 OCCUPANCY SENSORS: REFER TO SPECIFICATION SECTION 260923.

2.07 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices. Refer to drawings for requirements.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with gasketed lockable flap-type "extra duty weatherproof-in-use" cover.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. 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.
- C. 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 comply with 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.
- D. Device Installation:
 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. 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.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. 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.
- F. Dimmers:
 1. Install dimmers within terms of their listing.
 2. Verify that dimmers used for fan-speed control are listed for that application.
 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.
- G. 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.
- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use clear adhesives label with black letters on face of plate, and durable wire markers or tags inside outlet boxes.
- C. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.

3.04 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
- D. Tests for 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.
- 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

**SECTION 262813
FUSES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Enclosed switches.
 - 2. Spare-fuse cabinets.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in the General Trades Specification Sections include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.

4. Coordination charts and tables and related data.

1.06 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.

1.07 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 1. **Bussmann; Eaton, Electrical Sector.**
 2. **Littelfuse, Inc.**
 3. **Mersen USA.**
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 1. Fuses shall be dual-element, time-delay, rejection style, Class RK-5 for fuses up to 600 amperes; Bussmann type "FRN" (250 volt) or type "FRS" (600 volt). Larger fuses shall be Class L, bolt-in style; Bussmann "Hi-Cap".
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.03 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 2. Finish: Gray, baked enamel.
 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Architect.

3.03 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

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**SECTION 262816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- F. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- G. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.02 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.

1.03 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.

1.04 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 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. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Data: 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.
- C. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in the General Trades Specification Sections, include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

1.08 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.
 2. Fuse Pullers: Two for each size and type.

1.09 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches 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 an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.02 FUSIBLE SWITCHES

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **Square D; Schneider Electric USA.**
 - 2. **GE/ABB**
 - 3. **Eaton**
 - 4. **Siemens Industry, Inc., Energy Management Division.**
- B. Type HD, Heavy Duty:
 - 1. Safety switches shall be heavy duty, H.P. rated, 250 or 600 volts AC rated to match the circuit shown, with ground lug, rejection style fuse clips and NEMA 1 enclosure indoors or NEMA 3R enclosure outdoors.
- 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. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.
 - 7. Service-Rated Switches: Labeled for use as service equipment.

2.03 NONFUSIBLE SWITCHES

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **Square D; Schneider Electric USA.**
 - 2. **GE/ABB**
 - 3. **Eaton**
 - 4. **Siemens Industry, Inc., Energy Management Division.**

- B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 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.
- E. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. 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. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.
 - 6. Service-Rated Switches: Labeled for use as service equipment.

2.04 RECEPTACLE SWITCHES

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **Square D; Schneider Electric USA.**
 - 2. **GE/ABB**
 - 3. **Eaton**
 - 4. **Siemens Industry, Inc., Energy Management Division.**

2.05 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) or gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.02 PREPARATION

- A. 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 Architect and Owner no fewer than seven 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 Architect's and Owner's written permission.
 4. Comply with NFPA 70E.

3.03 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.

3.04 INSTALLATION

- 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.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

3.05 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections for Switches:
 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.

- d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
- e. Verify that fuse sizes and types match the Specifications and Drawings.
- f. Verify that each fuse has adequate mechanical support and contact integrity.
- g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
- i. Verify correct phase barrier installation.
- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
- 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- E. Tests and Inspections for Molded Case Circuit Breakers:
 - 1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that the unit is clean.
 - e. Operate the circuit breaker to ensure smooth operation.

- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
 - h. Perform adjustments for final protective device settings in accordance with the coordination study.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

- f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.
 1. The test and inspection report shall include the following:
 - a. Summary of project.
 - b. Description of equipment tested.
 - c. Description of tests.
 - d. Test data.
 - e. Analysis and recommendations
 2. Test and inspection data records shall include the following minimum requirements:
 - a. Identification of the testing organization.
 - b. Equipment identification.
 - c. Humidity, temperature, and other conditions that may affect the results of the tests/calibrations.
 - d. Date of inspections, tests, maintenance, and/or calibrations.
 - e. Identification of the testing technician.
 - f. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
 - g. Indication of the expected results when calibrations are to be performed.

- h. Indication of "as-found" and "as-left" results, as applicable.
 - i. Sufficient spaces to allow all results and comments to be indicated.
- 3. The testing organization shall furnish a copy or copies of the complete report as specified in the maintenance testing contract.

3.07 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 262816

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SECTION 265119
LED INTERIOR LIGHTING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for; 2025a.
- D. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. LED luminaires:
 - 1. Reference drawings and fixture schedule for types of LED luminaires and additional information.
- B. Related Requirements:
 - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.04 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
 1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.06 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Luminaires.
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 4. Structural members to which equipment and/or luminaires will be attached.
 5. Initial access modules for acoustical tile, including size and locations.
 6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Product Certificates: For each type of luminaire.
- D. Product Test Reports: For each type of luminaire, for tests performed a qualified testing agency.
- E. Sample warranty.

1.07 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.

1.08 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. LED boards/Strips/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.
4. LED drivers: Ten for every 100 of each type and rating installed. Furnish at least one of each type.

1.09 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. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.11 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.
- C. Warrant lamps for 5 year period for all LED lamp applications. Upon lamp failure, before the end of the 5 year period, contractor shall replace lamp and provide labor during the warranty coverage.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Ambient Temperature: 41 to 104 deg F.
 1. Relative Humidity: Zero to 95 percent.
- B. Altitude: Sea level to 1000 feet.

2.02 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.

- C. Recessed luminaires shall comply with NEMA LE 4.

2.03 MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE PRODUCTS BY ONE OF THE FOLLOWING:

1. **Lithonia**
2. **Cooper**
3. **Cree**
4. **Philips**

2.04 MATERIALS

- A. Metal Parts:
1. Free of burrs and sharp corners and edges.
 2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Steel:
1. ASTM A36/A36M for carbon structural steel.
 2. ASTM A568/A568M for sheet steel.
- C. Stainless Steel:
1. 1. Manufacturer's standard grade.
 2. 2. Manufacturer's standard type, ASTM A240/240M.
- D. Galvanized Steel: ASTM A653/A653M.
- E. Aluminum: ASTM B209.

2.05 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.

2.06 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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.

3.03 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
 - 1. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.04 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.06 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

**SECTION 265213
EMERGENCY AND EXIT LIGHTING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- F. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Emergency lighting.
 - 2. Exit signs.
 - 3. Materials.
 - 4. Luminaire support components.

1.04 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - 1. Include data on features, accessories, and finishes.
 - 2. Include physical description of the unit and dimensions.
 - 3. Battery and charger for light units.
 - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.

- a. Testing Agency Certified Data: For indicated luminaires and signs, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires and signs shall be certified by manufacturer.
 - b. 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. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule:
 - 1. For emergency lighting units. Use same designations indicated on Drawings.
 - 2. For exit signs. Use same designations indicated on Drawings.

1.06 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Suspended ceiling components.
 - 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 - 4. Structural members to which equipment will be attached.
 - 5. Size and location of initial access modules for acoustical tile.
 - 6. Items penetrating finished ceiling including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - 7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Product Certificates: For each type of luminaire.
- D. Product Test Reports: For each luminaire for tests performed by a qualified testing agency.
- E. Sample Warranty: For manufacturer's special warranty.

1.07 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.08 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: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

2. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.09 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Independent NRTL that is accredited under National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products and complying with applicable IES testing standards.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.11 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.
- C. Warrant lamps and fixtures for a 5-year period for all LED lamp applications. Upon lamp failure, before the end of the 5-year period, contractor shall replace lamps and provide labor during the warranty coverage.
 1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.
 2. Warranty Period for Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining six years.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for fluorescent luminaires.
- F. Lamp Base: Comply with ANSI C81.61 or IEC 60061-1.
- G. Bulb Shape: Complying with ANSI C79.1.
- H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.
 1. Emergency Connection: Operate one lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.

2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
 - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
 - c. Humidity: More than 95 percent (condensing).
 - d. Altitude: Exceeding 3300 feet.
4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
5. Battery: Sealed, maintenance-free, nickel-cadmium type.
6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
7. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.02 EMERGENCY LIGHTING

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 1. **Lithonia**
 2. **Cooper**
 3. **Cree**
 4. **Philips**
- B. General Requirements for Emergency Lighting Units: Self-contained units.
- C. Emergency Luminaires: As indicated on the drawings.
- D. Emergency Lighting Unit: As indicated on the drawings.
- E. Remote Emergency Lighting Units: As indicated on the drawings.

2.03 EXIT SIGNS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 1. **Lithonia**

2. **Cooper**
3. **Cree**
4. **Philips**
- B. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- C. Internally Lighted Signs: As indicated on the drawings.

2.04 MATERIALS

- A. Metal Parts:
 1. Free of burrs and sharp corners and edges.
 2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
 1. Smooth operating, free of light leakage under operating conditions.
 2. Designed to permit relamping without use of tools.
 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes: As indicated on the drawings.
- D. Housings: As indicated on the drawings.

2.05 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.06 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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 and emergency power unit weight.
 2. Able to maintain luminaire position when testing emergency power unit.

3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
1. Either attached to structural members in walls, attached to a minimum 20-gage backing plate attached to wall structural members or attached using through bolts and backing plates on either side of wall.
 2. Do not attach luminaires directly to gypsum board.
- F. Ceiling Grid Mounted Luminaires:
1. Secure to any required outlet box.
 2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.03 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.05 STARTUP SERVICE

- A. Perform startup service:
1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
 2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.06 ADJUSTING

- A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.
 - a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265213

**SECTION 284621.13
EXISTING FIRE ALARM SYSTEM**

PART 1 GENERAL

1.01 SUMMARY

- A. Related Requirements:
 - 1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for cables and conductors for fire-alarm systems.

1.02 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. NICET: National Institute for Certification in Engineering Technologies.

1.03 REFERENCE STANDARDS

- A. IEEE 1100 - IEEE Recommended Practice for Powering and Grounding Electronic Equipment; 2005.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
- E. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ACTION SUBMITTALS

- A. 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; Level III minimum.
 - c. Licensed or certified by authorities having jurisdiction.
- B. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, and profiles and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, details, and attachments to other work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Detail assembly and support requirements.
 - 5. Include voltage drop calculations for notification-appliance circuits.
 - 6. Include battery size calculations.

7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Include floor plans to indicate final outlet locations showing zone designation of each device. Show size and route of cable and conduits and point-to-point wiring diagrams.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in General Specifications include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide the "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
 - f. Record copy of site-specific software.
 - g. Provide the "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - h. Manufacturer's required maintenance related to system warranty requirements.
 - i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
 2. Installation shall be by personnel certified by NICET as fire-alarm Level III minimum technician.
- B. NFPA Certification:
1. Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).
 2. Obtain certification according to NFPA 72 by a UL-listed alarm company.

3. Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

1.08 PROJECT CONDITIONS

- A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 1. Notify Architect, Construction Manager and Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
 2. Do not proceed with interruption of fire-alarm service without Architect, Construction Manager and Owner written permission.
- C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.09 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 2. Warranty Period: Fiveyears from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with and operate as an extension of existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Noncoded system dedicated to fire-alarm service only.
- C. All components provided shall be listed for use with the selected system.
- D. 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.
- E. Existing Fire Alarm System: Simplex, a Johnson Controls Brand.

2.02 SYSTEMS OPERATIONAL DESCRIPTION

- A. Provide a complete and operable extension/completion to the existing fire alarm system, in accordance with the state building code and NFPA 72. Contractor shall field verify prior to bid, existing fire alarm system type, completion, capacity and expansion capability/limitation of adding new indicated devices. Contractor to provide upgrades as required to

accommodate relocation of existing devices and addition of new devices compatible with existing fire alarm system and of similar type model as existing devices, candela and DB rating per NFPA 72. Any addition/extension/completion to the system shall be complete with individually similar type to existing initiating devices, manual stations at perimeter doors, audio-visual signals, photo-electric smoke detectors at selected locations and air handling equipment. All fire alarm wiring shall be provided per the manufacturers recommendations. All horizontal cabling shall be supported per NEC. Provide 3/4" conduit from junction box with pull string and insulated bushing stubbed above an accessible ceiling or joist space for each new device. Provide all cards, modules, relays, programming and start-up.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF EQUIPMENT

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - 1. Connect new equipment to the existing control panel in the existing part of the building.
 - 2. Connect new equipment to the existing monitoring equipment at the supervising station.
 - 3. Expand, modify, and supplement the existing control or monitoring equipment as necessary to extend the existing control or monitoring functions to the new points. New components shall be capable of merging with the existing configuration without degrading the performance of either system.
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. 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. Install all devices at the same height unless otherwise indicated.
- E. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

- F. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.03 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch high.

3.04 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.05 PATHWAYS

- A. Pathways above recessed ceilings and in accessible locations may be routed exposed.
 - 1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.
- B. Pathways shall be installed in EMT.
- C. Exposed EMT shall be painted red enamel.

3.06 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.07 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.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.08 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction
- 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. Visual Inspection: Conduct the visual inspection prior to testing.

- a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in Chapter 10 "Fundamentals," Section 10.18.21 "Completion Documents, Preparation."
 - b. Comply with NFPA 72, Chapter 14, "Inspection, Testing, and Maintenance," Section 14.3, "Inspection" and the "Visual Inspection Frequencies" Table; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with NFPA 72, Chapter 14, "Inspection, Testing, and Maintenance," Section 14.4 "Testing" and the "Test Methods" Table.
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" 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.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with the visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.09 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 3. Perform tests listed in the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as well as others selected by Owner to adjust, operate, and maintain fire-alarm system.

END OF SECTION 284621.13